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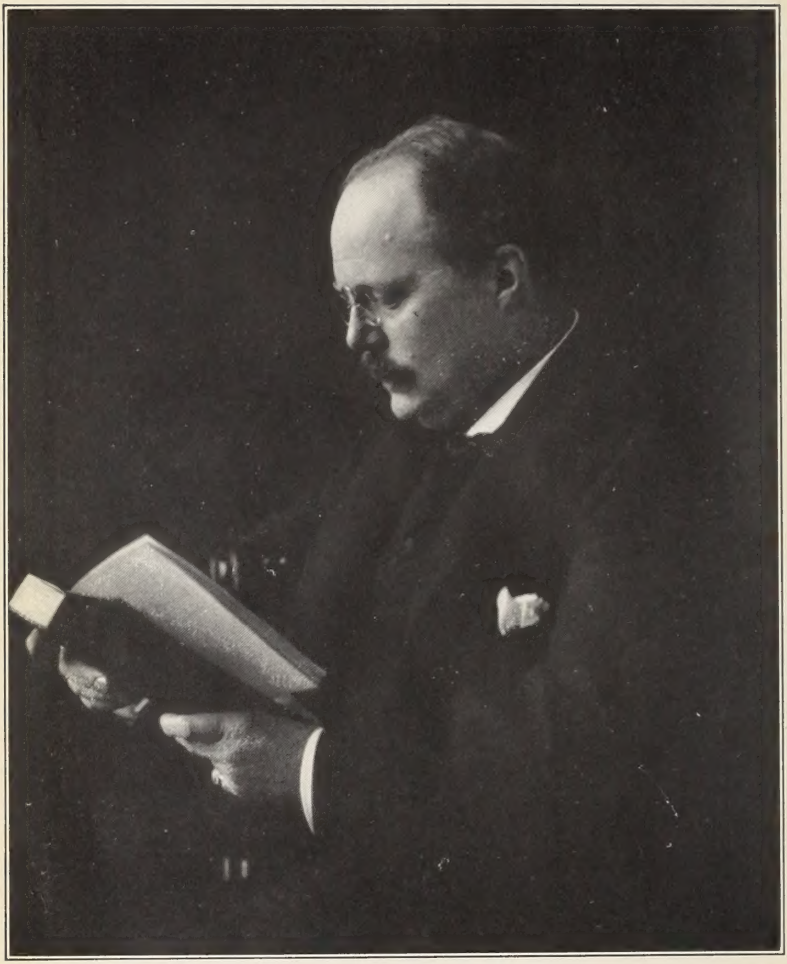

CLARENCE JOHN BLAKE, M.D.

TRANSACTIONS

OF THE

AMERICAN OTOLOGICAL SOCIETY,

FIFTY-SECOND ANNUAL MEETING.

HOTEL CHELSEA,

ATLANTIC CITY, N. J.

JUNE 16 and 17, 1919.

VOLUME XV. PART I.

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THE AMERICAN OTOLOGICAL SOCIETY.

The fifty-second annual meeting of the American Otological Society was held at Atlantic City, New Jersey, at the Hotel Chelsea on June 16th and 17th, 1919.

The following members and guests were registered during the meeting:

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J. P. HARBERT
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MINUTES.

Executive Session.

June 16, 9 A. M.

The President, Ewing W. Day, M. D., in the chair.

The minutes of the previous meeting were read by the Secretary, pro. tem. Dr. Thomas J. Harris. It was moved and seconded that the minutes be approved as read. Carried.

Report of the Committee on the Teaching of Oto-Laryngology was made by Dr. Harris. The Committee had held a number of meetings in which the matter had been very carefully considered. The feeling had been expressed that the war had emphasized the whole subject, and had made manifest the need of elevating the standard of the specialty. It had been suggested that a recommendation to the constituent societies be made as follows: That this Committee be authorized to proceed, through all the channels which seem to be available, to bring about a two years' course of teaching in Oto-Laryngology, and that pressure be brought to bear upon these various channels to this end. Among the channels through which this may be accomplished were named the Council on Medical Education of the American Medical Association, the Council of Graduate Schools, the American College of Surgeons, etc. It was requested that this statement be received as a report, and that the action suggested be approved, it being understood that the recommendation carries with it the inauguration of the two years' course. It was moved that the report be received and that the recommendations made therein be approved. Seconded. Carried.

The following nominations for officers for the ensuing year were made by the Council:

President—Robert Lewis, New York City.

Vice-President—Wells P. Eagleton, Newark, N. J.

Secretary-Treasurer—Thomas J. Harris, New York City.

Additional Members of the Council:

Norval H. Pierce, Chicago, Ill.

Ewing W. Day, Pittsburg, Pa.

Frederick L. Jack, Boston, Mass.

George E. Shambaugh, Chicago, Ill.

Moved and seconded that this report be accepted and adopted. Carried.

The Council recommended for membership Dr. Charles M. Robertson, of Chicago, proposed by Dr. L. W. Dean, of Iowa City, Ia., seconded by Dr. J. H. Bryan, of Washington. On motion, duly seconded and carried, Dr. Robertson was declared a member of the Society.

Communications were read by the Secretary from General Herbert S. Birkett and Dr. James E. Logan.

Report of the Secretary-Treasurer read. Moved and seconded that the report be accepted and placed on file. Carried.

On motion, duly seconded and carried, the president appointed the following Auditing Committee: Dr. Francis P. Emerson and Dr. Henry O. Reik.

On motion, duly seconded and carried, Section 2, Article II, of the By-Laws, was changed to read as follows:

"The Council shall consist of seven members: The President, Vice-President and Secretary, ex-officio, each retiring President—who shall be a member for two years after his term of office as President has expired—and two other members, one of whom shall be elected by the Society each year."

Moved and seconded that an assessment of five dollars be levied on each member of the Society to cover the printing of the Transactions of the Society. Carried.

The question of further meetings of the International Otological Congress was raised by Dr. Henry O. Reik, who asked whether this Society should take the initiative in the matter of corresponding with foreign delegates concerning the next meeting.

It was moved and seconded that the matter be referred to the Council, with power to act. Carried.

Dr. Dench read a letter from Dr. John Dutton, pioneer in the care of deaf children, concerning the reporting to the proper authorities of deafness in children.

Dr. Dench moved that a committee of three be appointed, to report at the next meeting of the Society, to formulate plans for reporting to proper authorities cases of deafness in children, and to suggest proper measures for the instruction of deaf children. Seconded and carried.

Election of Officers: It was moved and seconded that the Secretary be authorized by the chair to cast one ballot for the officers nominated by the Council. So ordered. The Secretary announced that one ballot had been cast, and that the officers were elected as nominated.

Report of Necrologist:

CLARENCE JOHN BLAKE, M. D.

I have been asked to write a few lines about the late Clarence John Blake, M. D., of Boston, Massachusetts. I shall not attempt to enumerate the offices which he held, the names of the societies of which he was a member or the papers which he wrote upon medical or other subjects. For all of these things I must refer to the records, which are compiled and kept for reference, concerning the lives of prominent men.

My endeavor will be to convey the impression which certain of Dr. Blake's characteristics made upon me during a fairly intimate professional companionship covering some twenty odd years.

First and foremost, I wish to speak of his great and unfailing kindness to his patients, whether hospital or private. Their welfare and relief were the *only* things which he thought about. No time (whether night or day) and no trouble or inconvenience were ever allowed to weigh for a moment against a possible benefit to the patient and he gave himself absolutely, both brain and body, to their service. Thousands of his patients are today lamenting his loss, not only because they have lost a skilled physician who helped their ailments,

but because they feel that they have also lost a friend who took an intense interest in all that affected them and to whom they could go for advice and counsel on any subject, whether medical or non-medical, with the certainty that he would give both time and thought to an endeavor to help them. This was a marked characteristic of Dr. Blake, and I wish to lay great stress upon it.

His intelligence was very keen, his mind very active. He saw more, and more quickly, than other men, and what he saw suggested all sorts of possibilities to him, of which he was very quick to make use. This was a great help to him in original investigation.

It so happened that Dr. Blake was among the first in this country who made a specialty of otology after the invention of the forehead mirror had revolutionized that branch of medicine by allowing the doctor to see into the ear. He therefore belongs to those who *created* the treatment of aural diseases, and he took advantage of his great opportunities and did his full share toward the rapid advances which were then made. He studied for a long time under Prof. Politzer, in Vienna, and was selected by him to be his assistant, a great honor, which showed how highly he was esteemed by Prof. Politzer; and he had a very enviable international reputation during his whole life, so that when his pupils went to Europe in after years the first question asked, as soon as it was known that they came from the Harvard Medical School, was: "How is Dr. Blake? What is he doing? Is there anything new scientifically from him?"

He was loth to cause pain and was exceedingly deft and skilful with his fingers, and he taught all who came under his tutelage how to perform all the painful and unpleasant things which an aurist has to do, with a minimum of pain and distress to the patient. This also I wish to lay stress upon, although it is a small thing, for it saved the patient from untold misery.

I first knew Dr. Blake when I applied as a volunteer during his service at the Massachusetts Charitable Eye and Ear Infirmary, and he was kindness itself in explaining and

showing me all that pertained to the anatomy of the ear and nose and to the diagnosis and treatment of their diseases. He was a wonderful and most interesting teacher, and no assistant or house officer has ever worked with him or under him without learning more from him than he could ever have learned from all the text-books in creation. I can freely say that he taught me the most of what I know about otology, although I often did not agree with him as to treatment. I knew him first as an assistant, then as a colleague, and for years he used to send certain cases to me for treatment, and we consulted together about them. If I was worried about a serious and dangerous case I always went to him for advice, and I have never done so, whether in the middle of the night or at meal times, or after his long office hours were over, that he did not give his best thought to the case; and if it seemed necessary he would go at once (whether by night or day) to see the case with me. He never failed me, and was never too tired to help a patient who was in pain or danger.

Dr. Blake and I differed many times and about many things, but my respect for his unfailing kindliness, his quick perceptions and his alert and resourceful mind was very great, and he certainly did a great deal for both the scientific and the practical side of otology.

HENRY LEE MORSE, M. D.

DR. CLARENCE JOHN BLAKE, BOSTON.

Dr. Blake was born in Boston on February 23rd, 1843, of old New England stock, and educated at the Latin School and Harvard, graduated M. D. in 1865. He then went to Vienna, where he took a further degree in obstetrics; but joining Politzer, he became his assistant and devoted himself henceforth to Otology. Returning to practice in Boston in 1869, he became at once a member of the new-formed American Otological Society, was made Aural Surgeon to the Massachusetts Charitable Eye and Ear Infirmary and Instructor in Otology at Harvard Medical School, and was

soon advanced to the Professorship of Otology, which he held until 1915, when he also resigned from the Infirmary.

He was elected Vice-President of the American Otological Society in 1873 and its President in 1876, and was always active in his valuable contributions to its programs and discussions, as also in the later-formed American Otological, Rhinological and Laryngological Society. His bibliography is rather too voluminous to be here given; but its titles show that he touched with masterly hand almost every topic in its special field and was a welcome contributor in broader fields, as when essayist of the Congress of Physicians and Surgeons. He edited the four volumes of the American Journal of Otology, 1879-82 and contributed ten valuable communications. Latterly he was especially known as the advocate of the blood-clot dressing of mastoid wounds, which has been vigorously assailed by some who had not learned its simple technique, but as warmly sustained by Reik, Holmes and the writer. He was one of the organizers of the International Congress of Otology in its first meeting in New York in 1876, always one of its Organization Committee and its President when it convened in Boston in 1912. What he was personally cannot be better told than by Henry Lee Morse, whose appreciation in the American Journal of the Medical Sciences is quoted in full. He died in Boston, Jan. 29, 1919.

DR. FREDERICK M. WILSON.

Dr. Wilson, of Bridgeport, Conn., died Dec. 30th, 1918. In spite of poor health, he had been a very regular attendant at our meetings, had contributed papers of value and joined in our discussions; but was even more usefully engaged in those informal talks outside of the regular sessions which constitute for many of us one of the chief advantages of our gatherings. Scientifically and socially his quiet, unassuming presence will be much missed by those who had the privilege of knowing him.

DR. NEIL J. HEPBURN.

Dr. Hepburn, of New York, a judicious and worthy practitioner of our specialty, died May 28, 1918. He was an interested listener rather than a speaker in our meetings; but his quiet comment upon the views presented by others was highly valued by those who realized what a practical touchstone his mind presented as to the new and renewed ideas in our programs.

DR. EDGAR M. HOLMES.

Dr. Holmes, of Boston, was the victim of a drowning accident on September 19th, 1918; and a valuable career, of which the first fruits were already marked in his endoscopy of the nasopharynx, was untimely cut short.

B. Alexander Randall.

The Auditing Committee reported that they had examined the books of the Treasurer and had found them correct.

Adjourned.

The USE OF THE PITCH RANGE AUDIOMETER IN OTOLOGY.

By L. W. DEAN, M. D., Iowa City, Ia., and C. C. BUNCH, M. A., Iowa City, Ia.

Two years ago I decided that the methods of testing the tonal ranges used in our clinic must be improved upon. It seemed to me that this could best be done by making practical application of facts already known to psychologists and physicists.

When I broached the matter to Prof. Seashore he suggested the appointment of a research assistant to work in otology and psychology, and to solve this problem if possible.

Mr. Bunch was appointed to fill this position. The instrument we now have is the result of his work.

The problem was to create an instrument that would measure the practical tonal range without skipping a note. It was desired to make it so that it would be a standardized instrument and at the same time be capable of doing the work accurately, and in a short period of time.

The instrument as we have it today is not a perfected machine. Its use is, however, far superior to any other method we have used in our clinic for measuring the practical tonal range. It has already suggested many new diagnostic points. As perimetry has developed ophthalmology, so may this method and other similar ones develop otology.

It is even conceivable that the exact determination of the interference with function in every note may result in lesions that are now classed as one disease, being separated into several distinct clinical entities.

In our clinic it has already replaced the tuning forks for testing the practical tonal range. Not only is it exact and in full detail, but it is a great time saver.

This report is made to show the work done and some results up to date. Our work is far from being complete.

A detailed description of this machine was submitted by Professor Seashore to the Psychological Division of the

National Research Council. The instrument was used during the war to test men for radio service. In this work many unsuspected defective individuals were found who had passed the other regular examinations for hearing.

The pitch range audiometer as we have it today, measures the tonal range from 30 double vibrations to 10,000 double vibrations; that is, the practical range of hearing.

The instrument has today in our clinic, three distinct practical advantages:

I. It measures the practical tonal range in much less time than can be done with the tuning forks.

II. It tests every note in the range measured while the forks test only a very few.

III. In 25 per cent. of our cases in the clinic, defects unsuspected after an examination with the Bezold forks, covering over an hour, are detected in two or three minutes with this instrument. A tone gap, partial or complete, of three or four notes only, lying in an area between the tuning forks, never suspected to exist, will be definitely demonstrated by this instrument. These gaps unsuspected in the clinical examination have been immediately discovered in many cases. The findings have been confirmed with the monochord and sometimes with the forks, or on the piano.

The examination of chronic non-suppurative forms of ear lesions confirms the observation recently made by Emerson that involvement of the nervus cochlearis is very commonly associated with them.

The nearest approach to this test up to the present time is that given by means of the Bezold forks, or some other similar set of forks. The forks which belong to the so-called "improved continuous sound scale," were first presented in 1890 at the International Congress of Physicians at Berlin. The "scale" consists of ten forks with movable weights, together with three whistles. These instruments are capable of producing all the tones in the hearing range. But the quantitative measurement with such a set of forks is very difficult. Bezold admits that "the examination of all ear patients with all sounds of the scale, as described, cannot

be carried out, if, for no other reason than because of the loss of time," but he inserts the reservation that "it is, however, absolutely necessary in the examination of all pupils of deaf-mute institutions," and also, "the examination with the whole scale is necessary for the establishment of complete deafness in one or both ears."

The inaccuracy of our standards in determining the hearing power is so well recognized as to hardly need mentioning. One man determines the power of hearing the fork by striking it on his knee, another uses a rubber hammer and a third uses his fingers, etc. One may find the tuning fork is not heard. One using a method of giving a note of greater intensity reports that the note is heard. With the tuning forks the intensity diminishes much more rapidly just after the fork is struck than later. The high forks diminish in intensity much more rapidly than low ones, so that the time element on tuning fork determinations as ordinarily done, is not in any way exact.

Professor Seashore has obviated this difficulty with the lower forks by having them electrically driven, and expressing the power of hearing in the distance at which the forks with constant intensity are heard. The higher forks, however, cannot be so driven. The apparatus needs constant skilled attention. The examination is time consuming and very fatiguing to the patient. The defect common to all tuning fork examinations of testing only a few notes is present.

The results obtained by this machine may be compared to perimetry of the eye; it is just as exact and just as complete. As it is used more it will surely be found that certain curves are suggestive at least of certain lesions. Already we have had otosclerosis undiagnosed, distinctly suggested in several cases with this instrument.

The steps regulating intensity can be varied at will and kept constant. All the notes in the tonal range can be tested with the same steps. The notes are relatively pure. This is corroborated in partial and complete tone gaps when the sound suddenly disappears and again reappears.

A machine like this once completely standardized would give the same results on the same patient with different instruments and with different observers in Europe and in America. This ideal instrument has not yet been secured.

The question of determining the high and low limits has not entered our problem. The low limit has been definitely proven by Professor Seashore to be twelve double vibrations. The high limit is not known. In determining it the question of intensity will play a very important role. In our cases, the high limits determined with the Galton whistle are hundreds of vibrations lower than when the Koenig cylinders are used—the Koenig cylinders have much greater intensity. It is not correct to say, after having determined the high limit with a Galton whistle, that the high limit is so and so, but only it is so and so for this particular whistle.

The instrument is an excellent one for rapidly and accurately determining malingering. In individuals deaf in one ear, we have found a constant definite cutting down of the apparent hearing in the deaf ear if the alarm apparatus is not used. With the alarm apparatus in the good ear, there is no sound perceived with the piece to the deaf ear. An individual claiming partial deafness in one ear would be detected because the curves representing the hearing in that ear, if the other were normal, would not be influenced by any great dimunition of hearing in the ear, but would be the normal curve for a normal ear on one side and a totally deaf ear on the other side. Curves made on successive days should be identical unless the ear condition is changing or the patient is malingering.

In testing the hearing of one ear it is always necessary to use a noise apparatus.

In measuring acuity for diagnostic purposes in otology or for practical purposes for determining the efficiency of hearing, we encounter six basic demands upon the measuring instrument:

(1) That it shall produce each and every tone within the significant range of tonal hearing.

(2) That this tone shall be pure.

(3) That it shall present favorable control of intensity.

(4) That the pitch and intensity shall be measureable.

(5) That either the pitch or the intensity may be varied with the other kept constant.

(6) That it shall be capable of rapid operation to avoid fatigue for the observer and to save the time of the experimenter.

The pitch range audiometer, fortunately, complies with these six requirements.

The following is a brief description of the instrument:

A more detailed description will appear soon (Iowa Studies No. VIII.).

If we take a magnet such as that used in a telephone receiver and attach to it another telephone receiver, and then lay a nail across the two prongs of the first receiver, we can hear a click in the other receiver when the nail is laid on and when it is taken off, as a result of the change in the electromotive force caused by bridging the two points of the magnet.

Now if we mount this receiver magnet in front of a toothed wheel so that each prong of the magnet will fit snugly in front of one tooth of the wheel, then the wheel becomes a bridge as the nail was in our first illustration. The magnetic current completes a circuit from one cog to the other. Now, if the wheel is revolved slowly, the cogs gradually recede from their magnetic points until they reach the maximum gap, and then the next pair of cogs will gradually make the bridge as before.

The pitch of this tone may then be varied by varying the speed of the revolving wheel. The wheel is driven by a direct current motor so adjusted as to produce any desired speed within our needs by the mere change of the slide on the rheostat. Thus, for example, when the motor is running very slowly, we have a corresponding low tone. By merely moving this slider along its scale we pass in a single sweep up to a very high tone as the wheel gradually speeds up.

There are two ways conveniently at hand for varying the intensity at a given pitch. One is to vary the distance of

the magnet from the wheel, as is done by the lever in Fig. I. The other is by means of resistance in the telephone circuit, and here again we have two possibilities—we may either introduce the resistance in series with the magnets or we can use the resistance as a shunt, that is, a bridge across the receiver circuit, thereby splitting the circuit. The latter method is the one we have finally adopted.

The pitch is measured in terms of the speed of the revolution of the wheel because one vibration is produced for the passing of each tooth. The electric tachometer offers a convenient method for securing this measurement and is in use at the present.

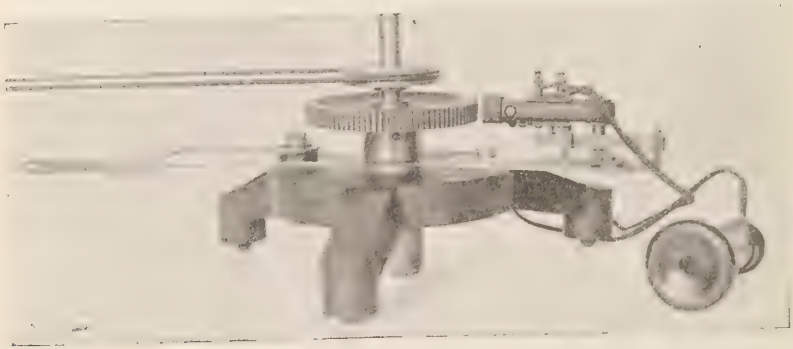


Fig. I.

This very simple contrivance then embodies the essentials of our apparatus, but we were compelled to discard it because it was impossible to secure soft iron of sufficient uniformity, in magnetic qualities to guarantee a smooth tone. To overcome this difficulty, at the suggestion of Professor Ford, we have adopted the plan formerly tried out in commercial motors of having as many magnets as there are teeth on the wheel, in order that we may get the cumulative result from all the magnets at the passing of each tooth.

In Fig. II, the final model, we see two sets of teeth. The upper one corresponds to our cog wheel; the lower one corresponds to our telephone magnet. In this lower one, each tooth is a pole, being made a series of magnets by passing an

electric current through a coil of wire lying inside of the teeth.

The procedure in conducting the tests is very simple. The noise of the machinery may be eliminated by placing the motor in some distant room and having electric control for the experimenter who is seated in a quiet room with the patient. The patient holds the receiver to his ear and indicates by some noiseless method that he hears the tones.

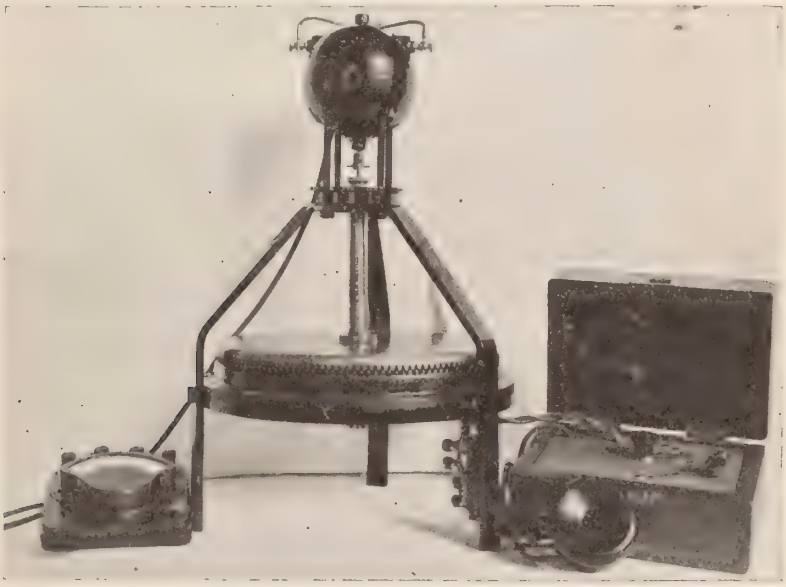


Fig. II.

After giving the patient such instructions as are necessary, the experimenter is free for the manipulation of the apparatus and recording the results. He begins by throwing in the shunt a certain resistance which will give a strong tone in the receiver. The motor is then slowly speeded up until the entire tonal range is covered. Frequent control trials should be interspersed, periods at which the current is shut off from the telephone. This accomplishes two purposes. It keeps the attention of the patient at a maximum, and it secures the

quick responses necessary for the exact location of short gaps. Now if there are any tones which are inaudible at this intensity, the patient will so indicate it. The point where he first indicated that he heard the sound, points where the sound became either audible or inaudible, and the point where he ceases to hear at the higher limit. If such point exists, all are recorded. Results are most descriptive when arranged in the fork of a graph. A convenient method of making the graph is to have the intensity steps for the vertical scale, and the frequencies recorded at the bottom as a horizontal scale.

The tones at this intensity having been observed and recorded, the experimenter sets the resistance at the next fainter step and the procedure is repeated. It is seldom necessary to repeat at any step except to find the exact location of gaps, since each succeeding fainter trial offers a check on all the trials which preceded. Any indication of ability to hear a faint sound where before a louder sound had been inaudible, indicates a lack of close observation or carelessness in recording results.

Danger of fatigue is largely eliminated because the pitch of the tone is constantly changing and, moreover, the entire test should not require more than fifteen or twenty minutes.

Returning to the requirements of an instrument like the pitch range audiometer, let us check up and see what is accomplished in this new instrument.

(1) It produces each and every tone within the significant range of tonal hearing without any gap whatsoever.

(2) It produces a relatively pure tone, pure enough for all practical purposes; and we have at our command the mechanical principles which determine the form of the sound wave.

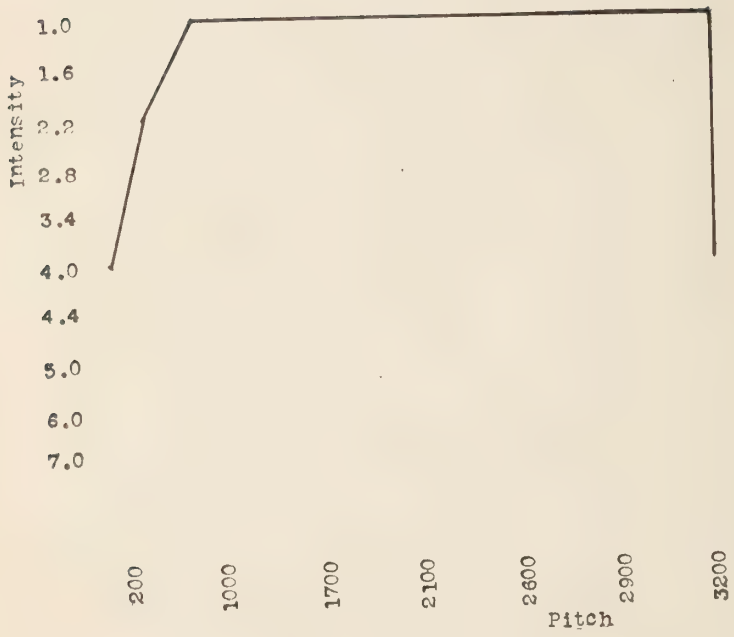
(3) It furnishes us a convenient method of varying the intensity from below the threshold up to a sound that is on the verge of being painful for any pitch.

(4) It enables us to record and measure instantly and with precision and at the time of hearing both the pitch and the intensity of the tone.

(5) It enables us to sweep through the entire range of pitches at one stroke for any steps controlling intensity and to sweep through at a single stroke all the intensities for a given pitch.

(6) The operation of the instrument is so simple and quick that a complete measurement can be made in a very small fraction of the time employed in making the ordinary tests now in vogue with otologists.

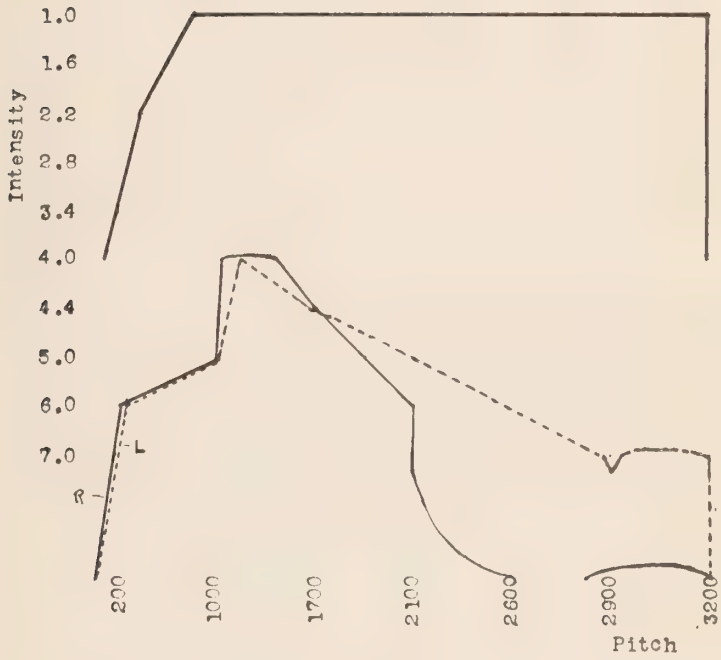
C H A R T I.



NORMAL EAR.

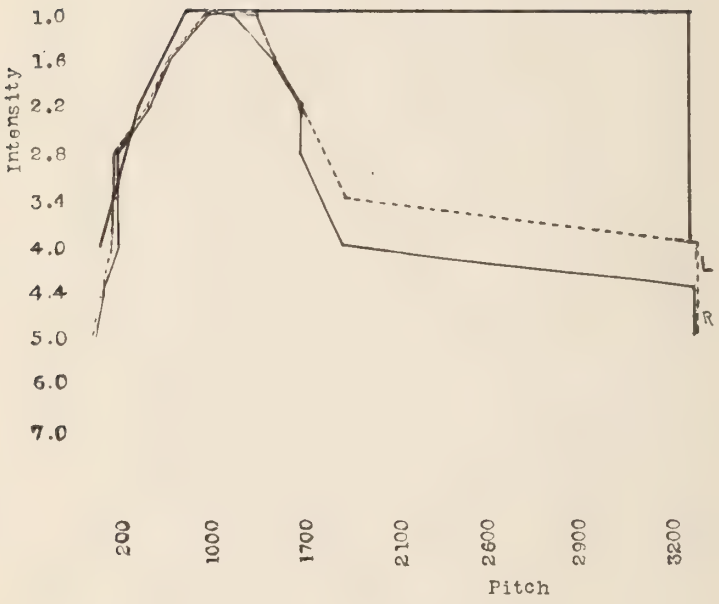
14 best records from tests made on
32 wireless students in the Army Vocational School.

CHART II



Diagnosis Adhesive Catarrh of Middle Ear.
Labyrinthine Lesion.

CHART III



Date Oct. 31, 1918

Diagnosis Neuritis of Eighth Nerve.

Secondary to Chronic Tonsillitis.

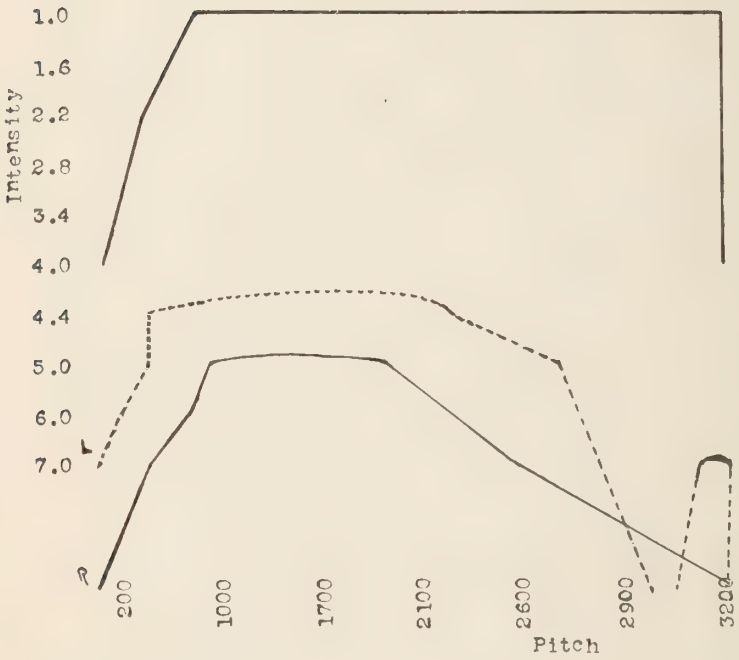
Chart before removal of Tonsils.

CHART IV

Date Jan. 15, 1919 Same case as shown on Chart III

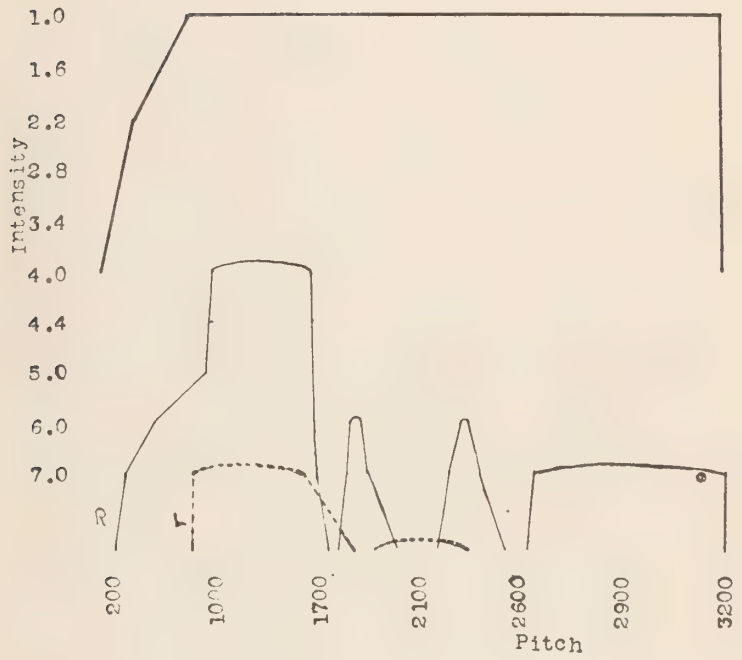
Chart 45 days after removal of tonsils.

CHART V



Diagnosis Otosclerosis.

CHART VI



Diagnosis Concussion Deafness.

Date May 24, 1919

Discussion.

Dr. Edward B. Dench, New York City, thought the Society should feel very proud to have this work presented at one of its meetings. The need of an apparatus of this kind had long been felt. Its general installation and use would undoubtedly lead to the clearing up of certain obscure otologic problems. The Society was under obligations to Dr. Dean and Mr. Bunch for their painstaking work.

Dr. Emil Amberg, Detroit, Mich., emphasized certain points which would insure the successful use of the apparatus. In the first place, the instrument should be manufactured by one concern. Mr. Bunch had pointed out that the variability of the electric current may affect the results. The parts of the apparatus should be cast all alike, otherwise a great many errors might follow. He asked Mr. Bunch to explain what advantages this instrument has over the simple siren instrument, and whether it is possible to measure the current of air or the rapidity of the wheel. It seemed to him that a simpler apparatus could be devised on the siren principle. If this audiometer were incorporated in the armamentarium of otologists, psychologists would be required to make the tests.

Dr. B. Alexander Randall, Philadelphia, Pa., had always been convinced that the acousticon and other similar instruments positively change the sounds, which they transmit to a lighter key. The same thing might be said of the telephone through which the sounds, with this audiometer, are transmitted. It was, therefore, a question whether the actual tone was ever represented,—an essential point in the value of this and all such instruments. While he could not at the moment offer any physical data for the changing of the tone, he very much questioned whether the low-tone and upper-tone limits are reliable. He would hesitate to change the views of Helmholtz, who doubted if tones below 32 d. v. s. or above 32,000 d.v.s., were actually audible to the human ear. Such instruments were apt to give rise to great fallacies.

Dr. Ewing W. Day, Pittsburg, Pa., mentioned the fact that Dr. Dean had agreed somewhat reluctantly to present this work at this meeting, for the reason that it was not completed.

Dr. Randall proposed a vote of thanks to Dr. Dean and Mr. Bunch, which was formerly passed.

Mr. Bunch, in closing the discussion, said, with reference to Dr. Randall's question concerning the changing of the tone, that the human voice is one of the most complex tones that can be produced, having all sorts of over-tones, which give it its beauty. The telephone receiver as now constructed will give not the low tones but the high over-tones and the secondary tones which come from the so-called "quality" in the human voice.

The methods of measuring electrical currents have been more highly improved than any other methods. It would be a very simple matter to put a voltmeter in the apparatus and to have always the same voltage. The decrease of one or two volts would not affect the tone enough to amount to anything.

The siren is a wind-driven instrument which gives various over-tones.

Doctor Dean, in closing the discussion, called attention to the fact that presenting the work which had been done, he visited Doctor Randall, and Doctor Randall went over his tests of hearing very carefully. It seemed to the speaker that something more exact than these tests should be created.

Referring to the matter of gaps, it was pointed out that Mr. Bunch had established a norm. The pathological conditions were represented by variations from this norm. They had found in one case a tone gap of three adjacent notes. This finding was confirmed in the laboratory on the organ pipe, monochord, and piano. This it seems, would suggest that absence of overtone. In other instances,

similar gaps although larger had been confirmed with the organ pipe, monochord, piano, and Bezold forks. He was convinced that the gaps which determined by us, of the instrument, are exact.

ORGANIZATION OF SECTION DEFECTS OF HEARING AND SPEECH. DIVISION OF PHYSICAL RECONSTRUCTION, SURGEON GENERAL'S OFFICE.

By Col. CHARLES W. RICHARDSON, M. S. R. C., Washington, D. C.

When the Division of Physical Reconstruction was first created, it was known as the Division of Special Hospitals and Physical Reconstruction, under the administration of Major Edward King. One of the constituent sections of this division was the section of Blind and the Defects of Speech and Hearing. This section was to be under the directorship of Major James Bordley, who was assigned from the section of Surgery of the Head, Division of Surgery, for this purpose.

On September 15, 1918, it was suggested by Lieut. Col. Theodore Lyster, the chief of the section of Head Surgery, that Major Charles W. Richardson, collaborate with Major James Bordley, taking charge of the section of Defects of Speech and Hearing. Immediately after Major Richardson's designation for work in the field, he called a meeting of several representatives of the deaf, and physicians interested in this work, to a meeting to be held in Washington on Saturday, Sept. 22, 1917. Present at this meeting were Miss Amelia N. Berry, representative of the New York School for the Deaf; Dr. Percival Hall, president of the Columbia College for the Deaf; Dr. Max A. Goldstein of St. Louis, and Major Charles W. Richardson.

After a thorough consideration of the plans of organization and the methods to be adopted, a scheme of the plan was left for Major Richardson to formulate and present to Major James Bordley for the consideraton of Major King. The principal idea conveyed in this connection was:

1. Consideration of the methods of the physical treatment of the defects of hearing and speech at the front.

2. The re-education of the deaf and the correction of the speech defects.

(a) At the Front immediately after the injury or disease.

(b) Transportation from the front to the interior districts where the re-education could be begun, or transportation to the United States where the re-education could be carried on under better circumstances and to greater advantage.

3. It was decided that in re-education of the near or completely deaf, one method should alone be followed, that is speech reading. It was admitted that there possibly would be a few to whom the manual method would have to be given.

4. After a thorough consideration, the Muller-Walle system was adopted. It was suggested that the Nitchie method should not be overlooked.

5. Teachers: Those at the meeting seemed to think it would be impossible to obtain enough teachers to meet the demands. It was decided, therefore, to suggest a method of educating teachers for the work that was thought to be in view. It was decided that teachers should be between the age of 25 and 45.

6. In connection with speech defects, attention was called to the fact that a number of these defects would probably be traumatic in origin, and therefore would require a certain amount of plastic restoration before the speech correction, through teaching, could be instituted.

7. Rehabilitation: The consideration of this important feature in connection with these defects, especially of hearing, was thoroughly considered. The submission of these tentative plans was followed by a request from Major James Bordley, requesting an elaboration of the plan suggested by this committee. This was followed by a communication to Col. Edgar King, attention of Major James Bordley, subject, Reconstructon of the Deaf.

In this communication it was suggested that an attempt should be made for a thorough canvass of the teachers of lip reading of the United States.

It was suggested that the physical treatment in connection with the defects of hearing and speech, be carried out as completely as possible before the return of the patient. It was considered advisable that all methods of re-education should be done in the United States. Very definite reasons were given why it was not thought feasible to start the re-education abroad:

(a) The soldiers needing this treatment could not be properly selected and segregated abroad.

(b) The place and environment for the teaching of the defective soldiers would be unfavorable.

(c) The difficulty of maintaining proper supervision of re-educational work of this type abroad.

(d) The adding of our burdens abroad by the prolonged maintenance of useless combatant elements in foreign lands.

(e) The great additional expense and the difficulty of obtaining competent teachers for service abroad.

It was suggested that re-education of the defects in hearing and speech could be done within the walls of the U. S. Army General Hospitals, but attention was called to the fact that this work could be much more easily or ideally done in a specially created home or institution, solely devoted to this purpose.

A thorough discussion of the methods of educating and training cadet-teachers for the work in hand, and the expense incident thereto was detailed.

Attention was called to the necessity of vocational re-education for some of the deaf. It was pointed out that shops would be required and the necessity for the creation of an adequate vocational force to meet these requirements was emphasized.

Attention was called to the fact that the public employment agencies and the industrial organizations throughout the country, must be convinced that the deaf are not abnormal people, but are perfectly normal beings who have substituted one sense for another in which they have been handicapped.

In this connection attention was called to the fact that the

Rucker bill, now before congress, had in consideration the establishment of a bureau in the Department of Labor for assisting in the information of employers about deaf working men, and to help the latter to obtain employment.

To this was appended a communication from Major Blair with regard to the plastic correction of maxillo-facial injuries. This communication lay dormant for a period of nearly five months. No action, either positive or negative, was taken in regard thereto.

During a greater portion of this time, from October 25th to March 11th, Major Charles W. Richardson was acting as chief of the section of Oto-laryngology in the absence of Major H. P. Mosher. The Division of Physical Reconstruction was undergoing its organization in many of its departments, and there seeemed to be very little interest in the section of Defects of Hearing and Speech. During this period, the subject of this section and its future activities, was under our consideration. Investigation had led us to change our views with regard to certain important features in connection with the former communication sent to Major James Bordley. The number of probable patients did not seem so great as we had been led to believe. Most all statistics obtainable were at fault and disagreed. The nearest information that we could obtain was that there would be about 2% of defects along these lines in all casualties. The fact that the American registrants were subject to a more rigid physical examination, and that certain types of cases were entirely eliminated from the service, led us to believe that the number of defects in the American army would not be over 1 or even ½ of 1%. It was thus evident that our whole plan of organization could be built upon a different basis.

We found after a systematic investigation at the source, that a number of teachers could be obtained for speech reading and corrective speech work. We also found that these teachers were more than willing to give up their occupations to enter into the service. We, therefore, considered it abso-

lutely unnecessary to even consider the question of educating a class of teachers to enter into this service.

On March 1st, 1918, Major Richardson was notified by Lieutenant Colonel Edgar King that he was to assume charge in the division of Special Hospitals and Physical Reconstruction, and was advised that he immediately acquaint himself with the details of the work, to separate the section from Major James Bordley's work in connection with the blind, and that he proceed to make plans for the proper organization of the section.

On March 8th, 1918, official orders were received relieving Major Charles W. Richardson from his duties in the section of Otolaryngology, as soon as he could complete his work, and assigning him to the Reconstruction division.

Major Richardson reported for duty March 11, 1918.

Immediate steps were taken for the purpose of obtaining a personnel of teachers in lip-reading. As a result of this effort, thirty-two teachers applied for service under army regulations; twenty-three teachers applied for service within their immediate vicinity; and twenty-six applied for service under various stipulations. A similar method was adopted in connection with the teachers for the defective in speech.

The securing of vocational instructors for the deaf was taken up. The hospital situation, as well as the proposed staff for each hospital, which is to be co-related with this work, was carefully considered.

Our organization is planned and outlined as follows:

ORGANIZATION
OF THE
SECTION OF TREATMENT OF DEFECTS IN HEARING AND SPEECH
IN THE
DIVISION OF SPECIAL HOSPITALS AND PHYSICAL RECONSTRUCTION.

Medical Staff: One Director in office of Section, Division of Special Hospitals and Physical Reconstruction; one Director

for service abroad: one Medical Officer to classify cases at point of debarkation, rank of Major; one Major, one Captain, two Lieutenants, at Hospital No. 11, Cape May, N. J.; one Captain, one Lieutenant, at Hospital No. 2, Ft. McHenry, Baltimore, Md.; one Captain, one Lieutenant at Hospital No. 9, Lakewood, N. J.; one Major, one Captain, one Lieutenant at Teaching Headquarters.

Civilian Staff: One Civil or Sanitary Officer as Office Assistant; one Stenographer.

Teachers: One Principal Instructor, to have charge of all of the Instructors at Teaching Headquarters; five Lip-reading Instructors, these with the principal are to be employed as soon as first teaching center is established and placed in order; five Vocational Instructors; two Instructors with practical knowledge of Music, for instruction in musical rhythm and amusement; one Masseur; one Drill Sergeant.

The question of compensation forms no element in connection with the employment of the medical staff in the reconstruction of the defective in hearing and speech as a result of the war, but it does with regard to all the civil employees.

It must be essentially recognized that most of the teachers to be employed by this division are individuals who have, after considerable study and expense, fitted themselves for a highly specialized type of teaching. The mental efforts to maintain practice and impart their knowledge is very great and exhausting. Their compensation in the private practice of their art is correspondingly renumerative; therefore, in the light of these facts it becomes necessary for us to consider carefully and thoughtfully the salary to be given these individuals. The compensation must be sufficient to dignify the position and enable the teachers to maintain themselves in befitting manner. From the fact that all of the individuals requiring reconstruction are males, and as most, if not quite all the teachers are female, and as all of the teaching is to transpire during the daylight hours, it seems therefore expedient that the teachers be permitted

to domicile themselves at other places than the actual teaching center.

Vocational Teachers: The deaf soldier will find it probably impossible to follow his former active occupation in life. He will be obliged to readjust himself according to the degree of his physical handicap. In order to fit himself for a new vocation, which he is required to master to place him among the respecting wage earners, it becomes necessary to have vocational teachers to instruct him to acquire knowledge of that industry to which he can apply himself, without being inconvenienced by his permanent handicap. Having prepared a list of vocations suitable for these handicaps—in which this handicap is a negligible quantity, we must seek and obtain the necessary corps of vocational teachers to meet the exigencies. These vocational instructors should, as the teachers above indicated, be compensated in proportion to the value of their services.

Speech Defects: Amusements. An essential feature in the training of the defects in speech is not only the amusement feature of music, but also the important psychological feature, as well as the physical restoration of the voice obtained thereby.

Teachers: Many of the deaf will require teachers to train their voices. There will return many wounded soldiers whose defects of speech will result from the injuries and resulting contraction about the face and air passages. These will require masseurs and teachers specially skilled in reducing contraction, and as aid in the proper restoration of the spoken language. As a result of shock injury, many modifications of voice, non-traumatic in character, will be brought under our observation. Under this class we will note the stammerers and other modifications of voice. We will also have many deaf whose control of voice will require restoration. The treatment of returned soldiers afflicted with these disorders will require highly specialized teachers for this work. These teachers should be under the supervision of one or more medical officers, who are experts along

this line of medical therapeutics. These teachers should have the same general consideration as the teachers to be employed in lip reading.

Compensation for Civil Employees: The principal instructor should have a compensation of two thousand to twenty-four hundred dollars a year, ($2,000 to $2,400 per annum). The teaching staff should be compensated according to their expertness—from twelve hundred to fourteen hundred per year, ($1,200 to $1,400 per annum). Musical instructors should be compensated at the rate of twelve hundred, ($1,200 per annum).

Masseurs should receive compensation of twelve hundred ($1,200 per annum).

Vocational instructors should receive compensation according to the character of instruction they give and their efficiency. We should be guided in this work largely by what is usually regarded as a proper salary for these workers—from twelve to eighteen hundred ($1,200 to $1,800 per annum).

Curriculum: In establishing the department of defects in hearing and speech, insofar as it is elementary teaching in its character, there will be required such regular pedagogic rules as prevail in all institutes, with the corresponding discipline, as all our students will be soldiers, the maintenance of discipline should be very simple.

It is proposed that an intensive course should be pursued in teaching, but not of such high tension as to cause mental fatigue to the pupils.

The period of study, before the pupil is fully prepared for discharge as a finished lip-reader, or defects of speech corrected, should not entail a period on the average of over six months. During this period of instruction for the deaf, and correction of speech defects, especially for the former, there is at the same time a course of vocational re-education to be carried out. Thus we shall have not only insured the handicapped the privilege of social and business inter-

course with his fellows, but have him also partially or completely re-educated.

The Course: All educational work should be undertaken in the forenoon. All vocational work in the afternoon.

Advance students during their vocational work will be able to practice their new found art.

The Deaf: The class work should be divided into three groups.

Lip Reading: (a) Lessons by trained teachers. This work should be carried out as individually as possible, each teacher having one pupil at each lesson. The number of pupils may be increased to four. One hour for each pupil or group.

(b) Practice: This work can easily be carried out in groups.

(c) Class work: Commencing at nine, each pupil could have three hours of work before the noon hour. The work will necessarily proceed in a circular method, and the pupil will necessarily have a different teacher for instruction.

The vocational instruction for the deaf is to be given in the afternoon hours.

In the evening moving picture views of lip-reading may be given to supplement the daytime work.

Defects of Speech: The correction of defects in speech is not attended with the same mental effort and consequent fatigue that is attended upon lip-reading; therefore, the afternoon hours may be employed for this purpose; the morning hours being employed in the vocational training for all of those who require or request re-education.

Time Required of Teachers: Each teacher should be able to do five hours work a day. Through the system which we have in view, three of these hours should be devoted to the teaching of soldier pupils, two of them to the training of cadets.

Each teacher available, should be able to teach from three to twelve soldier pupils per day.

It would be well to employ a few cadet teachers, who could be taught by the trained teachers in the afternoon hours. In the forenoon they should be employed in practice work with the students.

These Cadet-teachers need receive only a nominal pay during the period of cadetship.

Through this method, the probable necessary increase of teachers, as the war progresses, can readily be made.

We have now in view, already pledged, twenty-four lip-reading teachers, for service according to army regulations, prepared to go where their services are required.

We also have twenty-five teachers in lip-reading, willing to accept service at their own homes, and twenty-two willing to accept service under army regulations during school vacation, and other restriction. Enough from these classifications could be obtained to give us sufficient teachers to meet all our demands during the first year of military activities.

Numerous applications have been received of individuals who are both able and willing to become cadet-teachers. Most of these women are intellectual and give promise, if accepted, of making fine teachers on the completion of their cadetship.

A list of teachers for the defects in speech is now being prepared and when completed will also show as favorable results as for lip-readers.

There are two important features which we must take cognizance of in connection with the work; viz.: first, the color question which affects the defects in both classes: secondly, the inability of a very few to acquire the lip method of communication.

The color question can be solved, as it has been in educational work elsewhere, by segregation of patients and employment of teachers from northern states for the Negro.

The second question will only form a matter of consideration after the teaching center has been established for several months. Those who are too obtuse to acquire the oral method, after demonstrating their incapability, may

be transferred to other quarters where the manual alphabet is taught.

In teaching the manual method, a high degree of qualification is not necessary in the teachers.

The great disadvantage of the manual methods is that it does not permit the totally deaf to communicate with others unless they are conversant with the method.

Vocations: A small number of those made permanently deaf, through war casualty, may through re-education be enabled to follow the vocation which they pursued previous to their entering the United States Army.

A larger number, through defect in hearing, will be cut off entirely from their previous occupation and this requires vocational re-training.

It is well to remember that, in all of those already trained in vocations which are silent and without motion, re-education is hardly necessary. In the above mentioned occupation it is simply necessary to impress upon the employer the fact that a deaf individual is not an abnormal but a normal person, capable within a certain minor restriction of seeking and being able to take care of employment.

The types of employment which are opened to those deaf to the ears, but re-educated as to hear with the eyes are varied and numerous. Two methods of occupation are offered: viz., first, the out-door occupation; secondly, the in-door occupation.

Vocations in which the deaf should be re-educated are as follows, viz.,

In-door occupations: Printing; Engraving in all of its branches; Lithographing; bookbinding; chemistry; mechanical dentistry; draughting; photography and its allied arts; sign-painting; house-painting; interior decorating in all its branches; shoemaking; saddling; cabinet making; wood-working; artificiary in iron work; broom and mattress making; bookkeeping; electricity; engineering; plumbing; typewriting; library catalogue.

Out-of-door occupations: Carpentrying; bricklaying; scientific agriculture; scientific gardening; horticulture; mechanical and other work in garages; construction work; coopering; tin working; masonry.

A letter notifying candidates for position of teacher that their application had been received and that further detailed instruction might be expected was mimeographed and forwarded.

A building in Baltimore had been selected as the appropriate place for the location of the teaching institute for the Defects in Hearing and Speech, but as time dragged on without the consummation of the lease, the proprietors became impatient. Every effort was made to expedite the lease through the war department, and to steady the impatient owners but both efforts resulted in failure.

The plan of organization as detailed above presents theoretically very many attractive features, but when it came to the practical application of the work in hand, it was found that certain modifications had to be made. In order to bring in unison the activities of this organization with the various teachers of the deaf, and in order to get their co-operation, a number of the prominent educators were consulted. The necessity of considering the suddenly acquired deafness obtained in military service as being entirely different from the gradually acquired deafness in civil life, was pointed out. It was shown that the line of re-education was one that could only be carried on in an institution that was organized and designated solely for the teaching of the defect hearing and speech. The type of work that was being carried on by the teachers in large institutions was not the type of teaching in re-education that was necessary for these men. It was readily indicated and established that these men would not be satisfied by being treated at an established deaf and dumb institution. The only method to be employed to gain the confidence and support of the soldiers was either in a United States Army General Hospital or at a hospital designated for this purpose.

A diagnostic card which was to be entered up and form a part of the medical history of the patient was prepared. This

card received the acceptance of the division, but in some way it was apparently lost. Copy of this diagnostic chart had already been sent United States General Hospital No. 11, and it was used there for the purpose for which it was intended, although it had never been printed in the proper form. The chart as prepared for printing was afterwards found in the desk of an officer who had gone overseas.

After many plans had been suggested for the employment of an educational staff, the following plan was approved. In order to adequately start the work, an authorization was given for the employment of:—

1 Superintendent at.....	$3000.00 per year
1 Principal at	1800.00 per year
8 Teachers at.....	1000.00 per year

After this authorization, the question of appointing the teachers as head reconstruction aides at $60.00 a month with rations and quarters was suggested and accepted. This pay was more than equivalent of the $1000 which had been allowed, and removed the question of employment from the hands of the Civil Service.

In April, 1918, Captain John Ingersoll was assigned to General Hospital No. 11, in Otolaryngology, as surgical resident in charge of the section of Defects in Hearing and Speech.

It had been our intention and desire to start this work in a special hospital devoted to the treatment of re-education and rehabilitation of the defects in hearing and speech. Authorization for such purpose was not obtainable.

A well constructed and readily adapted summer hotel on the western outskirts of the city of Baltimore had been offered and accepted. It had every advantage that one could conceive for such an institution, excepting in one that it was not fireproof. After considerable delay the Hospital Division's request for the renting of this institution was approved by the General staff, but just before being approved by the general staff, the owners withdrew the offer.

As a result of the failure to secure the Mount Holly property in Baltimore, the Hospital Division designated General Hospital No. 11, Cape May, N. J. as temporary quarters for the section of Defects of Hearing and Speech until Mt. Holly became available, authorized April 23, 1918.

On account of the limitations placed on the director of the section, as a result of not being able to obtain the proper institution for this work, and as the director of the division of Physical Reconstruction seemed anxious that the work should be done in United States army hospitals, the necessity of enlarging the staff both here in the surgeon general's office, in the hospital and abroad was necessarily restricted.

The Hospital Division was particularly anxious that this section should have all the advantages of an independent hospital existence; should have an institute of its own; should have a staff of otolaryngologists in this institute and the general advantages, which would accrue from an independent existence. The patients would improve more rapidly and be under less limitations if they were entirely free from the surroundings and general depression of a U. S. A. general hospital.

As a result, the Hospital Division placed before us many offers of property for hospital purposes, which were small and seemingly very attractive both in location and in physical characteristics which would lend them to this purpose. We spent much time in inspecting the various places offered, but we found none acceptable. While many of the places donated for hospitals were attractive, others were wholly unsuitable, and would require large sums of money to remodel them into the necessary type of building, which we thought essential to do this work. So nothing along this line, after various arduous trips, could be found that would answer the purpose. Most of them were large summer residences of very rich people but frequently inappropriate places for hospitals, and to a certain extent inaccessible; none of these could be converted for hospital use except under large expense. In some cases this expense would be borne by the individual owners of the property, and others

would have to be borne by the U. S. government. Several large funds were offered to finance this sectional work in connection with these properties, but all that were investigated had some conditions attached which made it impossible even to consider them. We had the satisfaction though, of diverting a couple of these funds toward channels that would prove profitable to all. As all work in connection with individual hospital sites proved unsuccessful, we were at last obliged to open up our work in a very satisfactory quarter, and under the most satisfactory conditions at U. S. A. General Hospital No. 11. The commanding officer, Colonel Paul F. Straub, was an enthusiast in any endeavor which this section proposed to start in U. S. A. General Hospital No. 11.

On July 23rd at 7 P. M. there was inaugurated at General Hospital No. 11, the opening of the school for the treatment of defects in hearing and speech. This ceremony was attended by the staff, patients of the hospital and visitors. The opening address was made by Colonel Paul F. Straub, the commanding officer. It was followed by a few remarks by the director, Lt. Col. Charles W. Richardson, as to the scope of the work and the methods of treatment. The address of the evening was made by Major W. W. Keen, of Philadelphia, the subject being "Observations on the Difference Between the Medical Treatment During the War of the Rebellion and Those of the Present Day".

On July 24th the treatment was inaugurated with seventeen patients in attendance.

All patients were examined in the Otolaryngology section of the hospital by the staff under the direction of Major John M. Ingersoll. They were all tested out and their conditions noted as entirely satisfactory for the speech reading course. The complete deaf of whatever character were immediately assigned for speech reading. The near deaf, and those having deafness in both ears under 5/20, in which the condition of the ears indicate that the hearing would become progressive, although gradually worse, were assigned to the speech reading department.

Most of the cases we found had some degree of impairment of hearing before entering the service.

It is interesting to note that up to the period of December 31, 1918, we never saw what could be accurately designated as so called shell shock deafness. We have seen two cases that bear very close resemblance to shock concussions —that type of cochlea injury which is attendant upon those exposed to hours of intensive gun fire, in which high explosive shells predominate.

The course which we adopted in speech reading was of the individual instructive type. Each patient was given one-half hour instruction twice daily at the beginning. We found that two study periods a day were about sufficient for most men. They were given mirrors to study their own lip movements, and they were also given practice among each other. In fact, we found them very assidious in their efforts toward improvement. Anxious to gain all the advantages that could accrue from intensive work.

It is interesting to observe that all our white patients are fairly bright boys, who had recently become intensely deaf, not possessing any other type of injury, were more than anxious to remove this one handicap so as to be restored to normal. In the early days of our work we found there were a few recalcitrants, but later on as all new patients would see the value of the method as exemplified in other patients in all gradations of improvements, they became anxious to undertake the treatment.

Independently of the speech-reading work, we found that illiteracy was found among some of our patients, among some of the Americans and the naturalized foreign born. Illiteracy existed also among many of our native negroes. We also found that some foreigners could not pronounce the English language properly and had a very limited vocabulary. There not being enough work for our aides in speech correction, we decided to give the illiterates an opportunity to remove their handicap. It is astonishing with what rapidity our aides not only in the defect of hearing,

but also in corrective speech work, removed this impediment. Men who could neither read, write nor figure, would acquire the elements of speech-reading within a week or ten days, and then we would begin on them with the three R's, and usually a week thereafter we would have them writing, reading and doing simple problems in addition, subtraction, division and fractions.

I herewith exhibit the work of a foreigner named Warschoefsky, and secondly, of a negro named Charles Morris. We had men of French, Spanish and other nationalities with whom I could hardly converse on account of the difficulty of understanding their broken English. These were put on phonetic training, and within a short period, a week or ten days, we not only had them pronouncing English but also increasing the limits of their vocabulary. The limitation of our work in speech correction is very marked. Of course, we have so few patients come to us in this line. We have had a number of aphasics. It was most interesting to see how our aides in corrective speech work progressed with these aphasics, and how rapidly the latter improved. After December 1st, 1918, when the Maxello—for end cases began to return we found that we had more corrective work for our aides in corrective speech work than they had time to give.

On September 20th, the following definition was made in regard to the disposition of patients reaching the stage when they will be ready for classification for either discharge or be retained in limited service:

> "All patients who are nearly deaf, that is, below the normal register for acceptance into the service previously as recruits, and who have become proficient in lip reading, should be placed in class 'C', limited service, for employment in motionless activities only.
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> "Men whose hearing is reduced below 75% of normal, with deafness acquired in line of duty, who have become proficient in lip reading, but still hear very loud sounds, should be put in class 'D', with-

out regard as to motion or motionless activities.

"Patients who have more or less marked impairment of hearing, near or complete deafness, who still have a disease of the ear in the form of suppuration, or dry ears which will suppurate from time to time, however proficient in lip reading they may have become, should be discharged from the service.

"Patients, who, from want of concentration or from intellectual inability, cannot acquire proficiency or near proficiency in lip reading, and who have to depend upon other methods of communication, after due effort has been made on our part, should be placed in class 'D'."

It was interesting to find, that, contrary to expectation of some of the teachers of the deaf, we have had no case that required manual teaching. Even cases of the most unpromising character seemingly of the lowest type of mentality, have acquired the speech-reading art with unusual facility.

One man, an apparent wreck, came into U. S. A. General Hospital No. 11, without any history and without any papers. There was nothing known of him excepting that his name was Solomon. Where he came from and where he was to go, no one knew. He was deaf and dumb. The only effort of speech during the first two or three days was attended by considerable stammering, which made it impossible to understand that which he wished to say. The aide who was attempting to bring his defective organs into life, could not make out what he stated in these efforts. Ten days after this man had entered the hospital, and our aides had had him under their direction, he was reading speech slightly, but articulated his spoken words still with difficulty. Later we found out from another patient, who had been in the same hospital with him when abroad, that he was regarded as demented. This case was classed as psychoneurotic. That the man was deaf before he left the vessel

at Brest, there is no doubt from his own statement. He also gave convincing evidence, from an incident which occurred to him at Brest, that he must have been deaf at that time. Also there is no evidence of his having ever been exposed to high explosive shells. Within a few days after he had been in the hands of our aides, we obtained from him his name and home address, and two weeks after his entrance into the hospital, he gave an account of his whole history from the time of his entrance into the service until his return to U. S. A. General Hospital No. 11.

Appreciating the fact that there would be in all probability a certain number of cases coming into the hospital, who could be improved and whose hearing probably could be restored through resorting to the auricular method of training, we gave this subject a most thorough consideration.

After examining the various methods, which had been adopted by the various Allies in connection with this work, we decided that the auricular method, in which the human voice was employed, seemed the most logical and held out the best prospect of results. This is the method which seemed to be used most extensively, in the various French hospitals and institutions, to which the deaf are assigned. A full system of carrying out the auricular method to be used by the staff at General Hospital No. 11 was prepared.

In our work we intended to adopt individual methods of training, and if necessary, multiplication of this through phonographic attachment. The staff of this hospital, unfortunately have found this employment indicated only in one or two cases. The crest of our work reached its maximum during the first week in November. Since then there has been a gradual decline of the number of patients received, while the discharge has been greater than the increase in patients during November and December. We have, therefore, at the present time, nearly the same number of patients as when we started the work in July. Throughout our whole work in connection with this section, which has been from the beginning, we have attempted time and again to

obtain statistics as to the probable number of the near deaf and deaf, to the total number of casualties in the various Allied armies, so as to make, if possible, advance preparation for the patients we expected to receive. These efforts have been almost always without results. The nearest we have reached have been the statistics furnished by the British Pension Bureau, through Major Dundas Grant, viz.:

"The Director General's Office states that out of the total number pensioned for disability from the beginning of the war to May 31st, 1916, 2.9% were on account of deafness, while from the beginning of the war to May 31st, 1918, the percentage was 1.98. A further report states that from the outbreak of the war to August 31st, 1918, the total number pensioned for disability is 421,877; of these 7,731 are invalided on account of deafness, a percentage of 1.83."

These figures would indicate that we under the same conditions should have had the same ratio of deaf in connection with the total disabilities. We have expected less, and for two reasons: 1st, our men as registrants were more carefully examined, and those with defects in the auditory organs were refused as registrants. Some few of those who were accepted and taken into the service on re-examination, were excluded from overseas duty and retained for domestic service. In the second examination of recruits, all cases of suppurating ears, discharging or dry, were excluded, as well as those showing any catarrh in the middle ear. Those with any degree of impairment of hearing were accepted only for limited service. Secondly—a large number of the defects in hearing which occurred in the service of the Allies in this war, were no doubt due to trench warfare. Trench warfare practically closed with the entrance of the American army into the conflict, and therefore, a large percentage of ear afflictions which were due to trench warfare, were eliminated from our casualties.

These two factors were thoroughly considered in our preparation, and therefore, we are not disappointed, and hope that our opinion will be borne out by future results.

Results: In the French service it was expected that the average soldier would require about three months for a course in speech reading. In the British army it was expected that the same results would be obtained in four months. We had not expected, nor did we intend to make any effort to excel either the French or the British in this type of work. Our effort was simply to give our men the best treatment possible.

Our method has been an intensive one, giving the patient a couple of periods a day up to three, if such could be maintained without causing mental fatigue. We have expected also to find that some patients would not be able to grasp the method and continue the course. In this we have been disappointed. All of our men have shown energy in the work, keenness in desire, which has given a result far beyond our expectations. Not only have all the patients been able to read, but before they have been discharged they have been able to read speech well, not only with one person but with all people with whom they come in contact.

A couple of patients became interested in the touch method of studying, such as is resorted to by the blind in speech reading. Through the study of this method they have become proficient in reading through touch. When it was requested why they wished to use this method, they stated that they possibly might want to talk to people in the dark, and this would enable them to read what others stated.

The number of patients discharged from the hospital is 63, all of whom are good readers, and are able to take care of themselves. These individuals have no difficulty other than which is common to most proficient speech readers. Ordinarily it is not necessary for them to request a repetition of what is stated. In order to insure that none of these patients might lapse or deteriorate in their ability to read, but rather to be improved or be more perfect readers than they are at present, it was decided that all the patients discharged from U. S. A. General Hospital No. 11, should have the privilege of carrying on practice work at schools or with individual teachers in

their home town or near their home town. Arrangement was thus made with a number of schools and aides throughout the country to give the benefit of their work and effort to our discharged patients. A similar arrangement has been made with the Federal Board for Vocational Education. The same schools and aides that are to be employed by us have been given to the Federal Board for Vocational Education and they are to furnish practice and instruction to our patients after they have been discharged from the U. S. Army.

As each patient is discharged from U. S. A. General Hospital No. 11, he is given a duplicate copy of the name of the teacher or school to which he must apply. He is also given a note or card of introduction to the school or the teacher. Their names and home addresses are also given to the Federal Board for Vocational Education and they prepare to follow up these men and see that they continue the work and maintain the efficiency which they were given when they were discharged from U. S. A. General Hospital No. 11. Besides these results which are interesting, we have others which might be called secondary in their work. When the sectional work was first established we found that we had not enough work to keep our aides in corrective speech work employed. We found that there were illiterates coming into our hands. Through the efforts of our aides, all the illiterates coming into our department have had their illiteracy corrected. The rapidity with which this is accomplished is truly astounding. In a week or ten days the average man is able to write, to read simple stories, and do simple problems in arithmetic. In three or four weeks they read well any subject that may be presented to them. They write well and they are capable of doing any simple problem in arithmetic. When we take into consideration the number of illiterates that gain assignment in the United States army it is a pity that such aides as we have had, have not been assigned to various camps in order to correct this large amount of illiteracy. When we consider that the average adult illiterate could have been taught to

read and do arithmetical problems of simple character in three weeks, it would have been effort and time well expended. The corrective speech work, in connection with speech reading, has functionated to correct bad pronunciation.

In the foreign born, we found that while we were teaching them speech reading, we could at the same time correct their bad pronunciation. Another result of this effort was the increase of their vocabulary. Patients who one could understand only with difficulty, and who had a very limited vocabulary, within a couple of weeks, could speak nearly as correct English as their teachers, and with a wonderfully enlarged vocabulary.

On December 31, 1918, we find that the enrollment of candidates for head aides in the speech reading section amount to one hundred. All of these teachers signified their willingness to accept service on notice and under full army regulation.

In the speech corrective section, as to the same date we find fifty-one candidates enrolled to accept service as head aides, under full army regulations. We also had fifty-four candidates for speech reading, who were willing to give partial time service.

These facts are mentioned to demonstrate how well the country was canvassed for teachers of speech reading and corrective speech work.

Results: It is impossible to give more than a summary of the results we have attained both in the speech reading and the corrective speech work. We have discharged sixty-three patients from U. S. General Hospital No. 11 in the speech reading work. Of this number over fifty completed the course. The course was completed on an average in two months. We feel that the fifty who completed the course were as perfect speech readers as are ordinarily graduated from the best speech reading schools in this country. Our opinion, and that of our expert teachers, possibly prejudiced, is that they are far better perfected than the best students completing the course in the best civilian schools. I will quote from Captain Gordon Berry, who has been in charge of this work

for the past two months, as to why he considers our work is better and the reasons therefor:

1st. The grade of teachers, each of whom is an expert.

2nd. The altruistic spirit makes them more efficient in classroom work. They show an optimism as regards the patient that is infectious, cheering the discouraged, and stimulating the good worker to better endeavor.

3rd. The individual instruction which each patient receives.

4th. The fact that the deafness is recently acquired.

5th. The optimism created by working with others who can demonstrate their progress.

6th. The orderly arrangement of the day, the perfect system adopted. The military regime under which the patient lives and has his being conduced to easy discipline.

All of these reasons demonstrate that the theoretical plans upon which the system was instituted has practically evidenced its thorough utility.

Many military medical officers, as well as officers not in the medical corps have made inspections of our work, and have been markedly impressed and extremely enthusiastic over the work being accomplished, its rapidity of attainment and the results gained. Many of these officers were well prepared to judge of the character of the work in hand.

Many teachers of the deaf, noted principals of schools for the promotion of speech reading, and heads of deaf and dumb institutions made visits to U. S. General Hospital No. 11, and reviewed and inspected the work in progress. These people are the best judges of the character of work we are attempting to carry out and their opinion of it carries scientific value, so it is well worth noting.

We naturally were somewhat anxious as to their criticism and judgment of our efforts.

It will, no doubt, please you to know that they were unanimous in their approbation of our methods, delighted with the results which we were gaining, pleased with the possibilities, and congratulatory with the splendid work accomplished.

The most distinguished of these visitors were Dr. Crouter of Mt. Airy School, Philadelphia; Miss Yale and Miss Gaworth, of the Clarke School, Northampton, Mass.; Dr. Hall of the Gallaudet College, Washington, D. C.; Mrs. Marsh and Mrs. Berry of the Ohio School for the Deaf; Mr. Pope of the New Jersey Institute, and Mr. Steed of the Mt. Airy School, Philadelphia.

All of these visitors acknowledged that they had been more than repaid for the time and effort made in visiting Cape May. A compliment in itself. Dr. Hall, gave a lecture to his faculty on the work at Cape May, on his return from his visit, and although not present, I was told by one of the faculty that it was exceedingly complimentary as to our methods, system, teaching force and results.

The corrective speech work has been as excellent in its results as the speech reading. Indeed, all of the work in connection with speech corrections has been a revelation to those who have not previously known of its possibilities. It stands out as one of the most remarkable results attained by the Medical Corps in the history of the war.

I will close my paper by adding the summary of all cases treated by us up to May 31, 1919, followed by a graphic chart of the medical history of each patient.

Number patients under treatment:

Section of Defects of Hearing	31 patients
Section of Defects of Speech	25 patients
Total	56 patients

Patients having completed or partially completed courses:

Section of Defects of Hearing	63 patients
Section of Defects of Speech	12 patients
Total	75 patients

Patients enrolled since July 23, 1918:

Section of Defects of Hearing	99 patients
Section of Defects of Speech	37 patients
Total	136 patients

Deaf patients improving under treatment so as to render continuing courses unnecessary, 10 patients or 16⅔% of the number discharged from section:

Number totally deaf	28 patients
	29%

Number having had trouble previous to entering the service . . . . . 46 patients
47%

Countries represented in birthplaces 10

France, Russia, Poland, Italy, Norway, Ireland, Greece, Spain, America, Germany.

Average time for lip-reading course . . . . . 2 months

Daily schedule, 1½ hours per man, ¾ to ½ hour periods.
Number of Instructors.

Section of Defects of Hearing, from	July 23	to	Aug. 21	4
	Aug. 21	to	Sept. 3	6
	Sept. 3	to	Oct. 22	7
	Oct. 22	to	Feb. 1	8
	Feb. 1	to	May 1	7
	May 1	to	May 15	8
Section of Defects of Speech from	July 23	to	Aug. 21	1
	Aug. 21	to	May 15	3

Classification of Cases.
Section of Defects of Speech.

Aphasics	14 patients
Imperfect phonation cases	13 patients
Stammerers	3 patients
Aphasic and stutterer	1 patient
Multiple Neuritis	1 patient
Aphonia cases	2 patients
Stutterers	2 patients
Stammerers and stutterers	1 patient
Total	37 patients

Section of Defects of Hearing.

Cases which have completed treatment		63
In line of duty	43	
Not in line of duty	20	
Having Otitis Interna, result of gun fire		2
Shell explosions		8
Basal fracture		2
Meningitis		4
Other causes		9
Extension from middle ear		14
Deafness from catarrhal ears		9
Deafness from suppurative ears		22
Of the 22 suppurative ears, there were discharged dry		19
Cases hearing much improved		14
Otosclerosis		1
The labyrinth tests were not routinely done in all.		
Of six tests noted, there were sluggish reactions in		3
No reactions, or dead labyrinths in		3
Cases still under treatment		39
In line of duty	36	
Not in line of duty	3	

NAME			CAUSE OF DEAFNESS		L.O.D.	DEGREE OF DEAFNESS		PATHOLOGY	
	Admitted	Discharged	Primary	Secondary		On admission	On discharge	On admission	On discharge
1 J. M. A.	7 [illegible] 18	[illegible] 18	O. I. B. [illegible] Meningitis	None	Yes	R. whisper O. L. whisper O.	R. [illegible] O. L. [illegible] O.	None recorded	None recorded. Later dead
2 [illegible] A.			O. I. B. [illegible]	None	No	R. O. L. [illegible]		[illegible]	Same. Later dead
3 [illegible] H. A.	[illegible]	[illegible]	O. I. B. fr. [illegible]	Measles	Yes	R. [illegible] L. [illegible] O.	No change	None	None
[illegible]	[illegible]	[illegible]	O. M. [illegible]	None	No	R. whisper [illegible] L. [illegible]	[illegible]	[illegible] M. [illegible]	No change. No change
[illegible]	[illegible]	[illegible]	[illegible] M. S. [illegible]	None	[illegible]	R. [illegible] L. [illegible]	[illegible]	[illegible]	R. [illegible]
[illegible] M. I.	[illegible]	[illegible]	O. I. [illegible]	[illegible]	Yes	[illegible]	[illegible] L. O.	[illegible]	No [illegible]
7 [illegible] M.	[illegible]	[illegible] 19	O. M. S. C. Left. O. M. S. [illegible] Right	None	No. Yes	R. [illegible] L. [illegible]	R. [illegible] L. [illegible]	[illegible]	No change
8 [illegible]	[illegible]	[illegible]	O. M. C. C. Left. O. M. S. [illegible]	None	No	[illegible]	[illegible]	O. M. [illegible]	[illegible]
[illegible]	[illegible]	[illegible]	O. M. S. [illegible]	None. None	Yes	[illegible]	[illegible]	[illegible]	No [illegible]
[illegible]	[illegible]	[illegible]	O. M. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] drum retracted	None
[illegible]	[illegible]	[illegible]	[illegible]	O. M. S. [illegible]	No	[illegible]	[illegible]	[illegible]	No [illegible]
[illegible]	[illegible]	[illegible]	O. M. S. [illegible]	[illegible]	No	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] M. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	No [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible] M. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] A.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18 W. [illegible] H.	[illegible]	[illegible]	O. I. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	O. M. [illegible]	[illegible] O. M. S.	No	[illegible]	[illegible]	[illegible]	No change
20 [illegible]	[illegible]	[illegible] 19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] H.	[illegible] 18	[illegible]	O. M. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] S. M. [illegible]	[illegible]	[illegible]	O. M. S.	None	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	O. M. S.		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] P. W. [illegible]	[illegible]	[illegible]	O. M. S. [illegible]	[illegible]	No	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] B.	[illegible]	[illegible]	O. M. [illegible]. O. M. S. [illegible]	Same	[illegible]	[illegible]	[illegible]	[illegible]	No [illegible]
[illegible] K.	[illegible]	[illegible]	O. M. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27 [illegible] K.	[illegible]	[illegible]	[illegible]	[illegible]	No	[illegible]	[illegible]	M. [illegible]	No [illegible]
[illegible]	[illegible]	[illegible]	O. I. M. [illegible] bilateral		No	[illegible] O.	[illegible]	[illegible]	Same
[illegible]	[illegible]	[illegible]	O. I. M. [illegible]		[illegible]	[illegible]	[illegible]	[illegible]	Same [illegible]
[illegible] M.	[illegible]	[illegible]	O. M. [illegible]		[illegible]	[illegible]	[illegible]	[illegible]	Same
[illegible] M.	[illegible]	1[illegible] 18	O. [illegible]	O. M. S. [illegible]	Yes for O.	[illegible] O.	R. O. L. O.	[illegible] perf. [illegible] granulations	[illegible]
[illegible] M.	8 1 18	1[illegible]	O. I. [illegible] bilateral	[illegible] frontal [illegible] O. M. S. B.	Yes for O. I.	R. O. L. O.	R. O. L. O.	R. [illegible] perf. before [illegible]	[illegible] M. [illegible]
[illegible] J. M.	[illegible]	[illegible]	O. M. S. [illegible] O. M. C. Left		[illegible] Yes No	[illegible]	R. [illegible]	[illegible]	R. M. [illegible]
[illegible] J. M.	[illegible] 18	1 18 19	O. I. I.	O. M. S. [illegible] Left. O. M. S. [illegible] Right	Yes	[illegible]	R. O. L. O.	[illegible]	Do.
[illegible] A. [illegible] M.	1 6 18		O. I. from shell explosion	Same	Yes	R. [illegible] L. [illegible]	R. O. L. [illegible] ft.	Both drums slightly retracted	Same
[illegible] J. M.	[illegible]	[illegible]	O. I. Loss of left eye, shell explosion	Same	Yes	R. 4 ft. L. O.	R. 5 ft. L. O.	Both drums slightly retracted [illegible]	Same. Tubes sluggish
[illegible] S. A. M.	[illegible]	[illegible]	O. I. B. [illegible]	O. M. S. C. [illegible]	Yes	R. [illegible] L. [illegible]	R. [illegible]	Heavy [illegible] both drums	Same
[illegible] C. M.	10 [illegible] 18	1[illegible] 18	O. I. B. [illegible]	O. M. C. C. B.	Yes	R. O. L. [illegible] short	[illegible] L. O.	Drums [illegible]	Same
[illegible] G. F. M.	7 2 18	11 16 18	O. I. B. meningitis	O. I. [illegible]	R. Yes L. No	R. short L. O.	R. short L. O.	Drums thickened and retracted	Same
[illegible] F. M.	7 1 18	11 29 18	O. M. C. C. Bil.	O. M. S. C. B. [illegible]	No	R. [illegible] L. [illegible]	R. short L. [illegible]	Drums intact retracted	Same
41 J. M.	[illegible] 7 18	1 2[illegible] 19	O. M. C. C. [illegible]	Same	Yes	R. [illegible] ft. L. [illegible] ft.	R. 1 ft. L. 1 ft.	Both [illegible] thickened and retracted	Same
42 H. H. N. O. B.	9 [illegible] 18	11 [illegible] 18	O. I. [illegible]	O. M. C. C. B.	Yes	R. O. L. 1 ft.	R. O. L. [illegible] ft.	Both drums intact slightly retracted	[illegible] Tubes fused to [illegible]
43 F. P.	11 1 18	12/16/18	O. I. B. [illegible]	O. M. S. C. B.	Yes for O.I.B.	R. short L. O.	R. O. L. O.	Both ears discharging	Ears dry perforated
44 F. P.	1[illegible] 29 18	[illegible] 19	O. I. B.	Meningitis	Yes	R. O. L. O.		Drums normal	Dead [illegible]
47 B. P. P.	9 9 18	1[illegible] 18	O. I. B. [illegible]	O. M. S. C. B.	No	R. short L. short	R. short L. short	R. [illegible] perforation L. [illegible]	Ears dry perforated
46 C. L.	7 [illegible] 18	1[illegible] 20 18	O. I. B. [illegible]	O. M. C. C. L.	Yes	R. 1 ft. L. O.	R. short L. O.	Drums thickened [illegible]	Same
47 W. I.	[illegible]	In Hosp.	O. I. Right [illegible]. O. I. Left [illegible]	[illegible]	No. No	R. O. L. 2 ft.	R. O. L. 1 ft.	Both drums retracted [illegible]	
48 G. D. K.	7 20 18	11 24 18	O. I. B. with [illegible] from [illegible] fever in 1918 [illegible] O. M. S. C. B.	O. M. S. C. R. with [illegible] L.	Yes	R. 3 ft. L. 3 ft.	R. about L. about	R. [illegible]	[illegible] Mast. Op. done
49 R.	11 16 18	1 [illegible] 19	O. I. B. cause unknown	O. M. C. C. L.	Yes for O.I.B.	R. O. L. Loud [illegible]	R. O. L. loud [illegible]	[illegible]	[illegible]
50 J. S.	8/1 18	1[illegible] 18	O. M. S. C. Right. O. M. S. C. Left. O. I. Left		No. No. No	R. [illegible] L. [illegible]	[illegible]	Right drum perforated discharging. Left [illegible] retracted	Same
51 F. S.	7 9 18	11 2[illegible] 18	O. I. B. [illegible] fire	O. M. S. C. L.	Yes	R. O. L. O.	R. O. L. [illegible]	Both ears discharging	Ears dry. Drums perforated
52 S. S.	[illegible] 7 18	1[illegible] 18	O. I. B. cause unknown	[illegible]	Yes	L. O. L. O.	R. O. L. O.	Drums intact, thin [illegible] retracted	Same
[illegible] F. S.	1[illegible] 12 18	[illegible] 19	O. I. B. partial cause unknown	O. M. S. C. Right	No	R. [illegible] ft. L. [illegible] ft.	R. 5 ft. L. [illegible] in.	Both drums [illegible] dull and retracted	Same
54 T. P. S.	11 1 18	12 2[illegible] 18	[illegible] B.	Same	No	R. short L. [illegible]	R. O. L. 1 ft.	Both drums slightly retracted	Same
[illegible] I. S.	[illegible] 18	[illegible]	O. I. [illegible]	Same	Yes	R. O. L. O.	R. O. L. O.	Both drums normal	[illegible] Same
56 L. S.	6 1 18	11 [illegible] 18	O. I. B. cause unknown	[illegible]	Yes	R. 1 ft. L. O.	R. [illegible] L. O.	Both drums dull and retracted	Same
57 M. T.	[illegible] 26 18	1/10/19	O. I. B. fr. salvarsan	O. M. C. C. B. [illegible] sclerosis	Yes	R. O. L. O.	R. O. L. O.	Both ears normal	Same
[illegible] I. W.	11 [illegible] 18	11 [illegible] 18	O. I. cause unknown	O. M. C. C. B.	R. No L. Yes	R. [illegible] L. O.	R. [illegible] L. O.	Both drums intact slightly retracted	Same
59 O. W.	11 [illegible] 18	[illegible] 19	O. M. C. C. B.	[illegible]	No	R. [illegible] ft. L. [illegible] ft.	R. [illegible] ft. L. 1 ft.	Both drums [illegible] retracted	[illegible]
[illegible] H. M. W.	[illegible] 18	11 21 18	O. I. from Shell explosion		Yes	R. O. L. [illegible]	R. [illegible] L. [illegible] ft.	Both drums retracted and [illegible]	Same
61 J. W.	[illegible] 19	4 19 19	O. I. B. [illegible]	O. M. S. C. B.	Yes	R. 2 in. L. [illegible]	R. [illegible] ft. L. [illegible] ft.	Both [illegible]	Same
[illegible] B. W.	1[illegible] 18	1 1[illegible] 19	O. I. B. from shell explosion	[illegible]	Yes	R. [illegible] L. short		Both drums slightly retracted	Same [illegible]
[illegible] I. Y.	11 [illegible] 18	[illegible] 18	O. I. with [illegible] fever	O. M. S. C. [illegible]	Yes	R. [illegible] L. [illegible]	R. [illegible] ft. L. 1[illegible] ft.	Both drums retracted [illegible]	Same

SECTION OF DEFECTS OF HEARING — PATIENTS UNDER TREATMENT.

NAME.		CAUSE OF DEAFNESS.			DEGREE OF DEAFNESS.		PATHOLOGY.
Admitted.	Discharged.	Primary	Secondary	LOD	On admission	On discharge	On admission
1. B. B. 3/13/19	In Hosp.	O. I. B. from meningitis		Yes	R.-O. L.-O.	No change on 5/14/19	Both M. T. dull. Both Lab. dead
2. L. B. 5/6/19	In Hosp.	O. M. C. C. B.	Influenza	Yes	R.-1 ft. L.-5 in.	No change on 5/14/19	Both drums retracted
3. Lt. C. C. B. 4/4/19	In Hosp.	O. M. C. C. Right O. I. Left	Concussion shells, France	Yes	R.10 ft. L.-O.	No change on 5/14/19	Both drums slightly retracted. Both Labs. hypersensitive. Both drums normal
4. W. C. 10/24/18	In Hosp.	O. I. B. from meningitis		Yes	R.-O. L.-O.	No change on 5/14/19	Both drums normal. Both labs. dead
5. S. D. 11/19/18	In Hosp.	O. I. B. gassed O. M. S. C. Right	O. M. S. C. R. when a child	Yes	R.-O. L.-O.	No change on 5/14/19	Right drum thickened. Left drum healed scars. Both Labs. sluggish
6. P. D. 1/21/19	In Hosp.	O. I. B. from gun-fire	Meningitis	Yes	R.-Loud 1 ft. L.-Loud 4 ft.	No change on 5/14/19	Both drums slightly retracted. Right lab. dead
7. M. F. 2/8/19	In Hosp.	O. M. S. C. Right O. M. S. C. Left		R. No. L. Yes	R.-1 ft. L.-2 ft.	R.-4 ft. L.-4 ft. on 4/19/19	Profuse discharge from both ears
8. J. E. G. 3/29/19	In Hosp.	O. I. B. from meningitis		Yes	R.-O. L.-O.	No change on 5/14/19	Drums slightly retracted. Both Labs. dead
9. O. P. H. 2/11/19	In Hosp.	O. I. B. from concussion while working in a boiler shop in France	Syphilis	Yes	R.-1 ft. L.-1 ft.	No change on 5/14/19	Both drums thickened and retracted. Both Labs. sluggish
10. T. H. 12/22/18	In Hosp.	O. I. B. from meningitis		Yes	R.-O. L.-O.	No change on 5/14/19	Both drums normal. Both labs. dead
11. W. G. H. 3/7/19		O. I. B. from meningitis		Yes	R.-O. L.-O.	No change on 5/14/19	Both drums slightly retracted. Both labs. dead
12. A. H. Not admitted. Nurse on duty.		C. M. C. C. B.		No.	R. 4 ft. L. 4 ft.	No change on 5/14/19	Drums retracted
13. A. K. 4/11/19	In Hosp.	O. M. S. C. R. Right O. M. S. C. R. Left O. I. B.		1&3 Yes 2-No	R.-1 ft. L.-1 in.	R.-4 ft. L.-1 ft. on 5/14/19	Right drum shows a depressed scar. Left drum shows a perforation. Both labs. sluggish
14. C. L. 3/3/19	In Hosp.	O. I. B. from meningitis		Yes	R.-O. L.-O.	No change on 5/14/19	Both drums intact, but slightly thickened and retracted
15. W. S. L. 3/5/19	In Hosp.	O. I. from meningitis	None	Yes	R.-O. L.-O.		Drums normal, Lab. dead
16. Capt. E. L. 10/2/18	In Hosp.	O. I. (shell concussion	O. M. C. C. Left Syphilis, tertiary	Yes	R.-2 ft. L.-O.		Drums retracted—more on left
17. R. H. McC. 12/17/18	In Hosp.	O. I. B. from meningitis	None	Yes	R.-O. L.-O.		Labs. dead. Drums intact, negative
18. L. M. 4/3/19	In Hosp.	O. M. C. C. Right O. M. S. C. Left	Same	R. Yes L. No.	R.-4 ft. L.-6 in.		Right drum intact, thickened. Left ear discharging
19. Lt. V. G. M. 9/25/18	In Hosp.	O. I. Right, with labyrinthitis G. S. W.		Yes	R.-10 in. L.-20 in ft.		Right M. T. dull and retracted. Same Lab. sluggish
20. J. R. M. 4/18/19	In Hosp.	O. I. B. from gun fire	None	Yes	R.-1 ft. L.-2 ft.		Drums slightly retracted. Labs. hypersensitive
21. A. L. M. 4/2/19	In Hosp.	O. I. B. from meningitis	None	Yes	R.-O. L.-O.		Drums normal. Labs. dead
22. A. P. 3/29/19	In Hosp.	O. M. C. C. B.	Same	Yes	R. 3 in. L.-1 ft.		Both drums retracted
23. M. F. P. 33/29/19	In Hosp.	F. Otosclerosis bilateral	None	No.	R.-3 ft. L.-3 ft.		Drums slightly retracted
24. S. P. 2/25/19	In Hosp.	O. I. from meningitis	None	Yes	R.-O. L.-O.		Drums normal. Both Labs. dead
25. C. R. 5/6/19	In Hosp.	O. I. (shell concussion)	None	Yes	R.-O. L.-O.		Perforation both M. T. Labs. sluggish
26. T. E. R. 2/20/19	In Hosp.	O. I. from meningitis	None	Yes	R.-O. L.-O.		Drums normal, both Labs. dead
27. R. S. 3/7/19	In Hosp.	O. I. Right O. M. S. C. B.	O. M. C. C. B.	Yes	R.-1 in. L.-20 ft.		Rt. ear discharging. Left ear dry, small perforation. Both Labs. sluggish
28. Lt J. E. S. 4/27/19	In Hosp.	O. I. B.	O. M. C. C. B.	No.	R.-O. L.-8 in.		
29. A. S. 12/22/18	In Hosp.	1 GSW, parietal reg. 2 O. Det. partial	3 O. M. C. C. B.	3. No. 1&2 Yes	R.-5 in. L.-1 in.		M. T. retracted
30. Lt. C. W. S. 5/3/19	In Hosp.	O. I. B. shell concussion	O. M. S. C. B.	Yes	R. 7 in. L. 9 in.		Lower half drums destroyed. Muco-pus
31. M. U. 4/29/19	In Hosp.	O. I. B. shell concussion	O. M. C. C. B.	Yes	R. 4 ft. L. 1 ft.		M. T. retracted
32. J. F. W. 1/24/19	In Hosp.	O. I. B. shell concussion	None	Yes	R.-O. L.-4 ft.		Labyrinths normal. Right M. T. dull, retracted and scarred. Left M. T. retract.
33. L. W. 3/13/19	In Hosp.	O. I. with labyrinthitis-meningitis	None	Yes	R.-O. L.-O.		M. T. retracted. Lab. dead
34. J. C. W. 4/17/19	In Hosp.	O. I. B. with labyrinthitis-meningitis	O. M. S. C. Right	No	R.-O. L.-O.		Right M. T. perforated, chronic, disch. Labyrinths dead
35. T. W. 3/20/19	In Hosp.	O. I. B. labyrinthitis meningitis	None	Yes	R.-O. L.-O.		M. T. retracted. Labs. dead
36. W. Y. 2/11/19	In Hosp.	O. I. B. (Yes)	O. M. C. C. B.	LOD No	R.-1 ft. L.-1 ft.		Negative. Labyrinths sluggish

Having otitis interna, result of	gun fire	4
	shell explosion	6
	basal fracture	2
	meningitis	14
	other causes, other than middle ear	0
	extension from middle ear	6
Deafness caused by catarrhal deafness		2
	suppurative otitis	4
Four running cases, still here, now dry		3
Hearing much improved in		2
With otosclerosis		1

Almost all the labyrinths in this group were tested, and the balance will be:

Hyper-active labyrinths	2
Sluggish labyrinths	6
Dead labyrinths	12

These labyrinthine tests were done in the otitis interna cases. The "dead" labyrinths were in the otitis interna following meningitis cases.

"Shell-Shock Cases."

There were two cases of otitis interna from shell explosion. The otitis interna had cleared or nearly cleared when they arrived here. The deafness continued from hysteria. Under suggestion, and with rest, the hysterical condition cleared and the hearing became normal in each case. In one case only one ear returned to normal because the other ear had been deaf for years, a chronic condition. These two were cases which earlier would have been considered shell-shock cases.

Two cases died from meningitis, consequent on a chronic brain-abscess, secondary to a chronic otitis media, suppurative.

THE OTOLOGICAL WORK IN THE U. S. A. GENERAL HOSPITAL FOR HEAD SURGERY.

By J. M. INGERSOLL, LIEUTENANT COLONEL, M. R. C., Cleveland, Ohio.

In January, 1918, the Medical Department of the Army leased a modern fireproof hotel at Cape May, N. J., and converted it into a Hospital for Head Surgery, known in the army as U. S. A. Hospital, No. 11.

The building was renovated and the necessary equipment was sent to the hospital as rapidly as the Medical Department could secure it. At first the equipment was quite limited, but gradually it was augmented, and at the end of a few months was reasonably complete.

The work in the hospital was divided into the Ophthalmological Section, the Oro-Plastic Section, the Oto-Laryngological Section, and the Section for Brain Surgery, and later Peripheral Nerve Injuries were added to this department.

Associated with me in the Oto-Laryngological Section were the following men: Capt. Gordon Berry, Capt. H. F. Lampe, First Lieut. F. N. Bigelow, First Lieut. E. P. Longaker, First Lieut. H. J. Beard. Capt. H. P. Cahill was also a member of the Oto-Laryngological staff until August 10th, when he was assigned to Unit 115, and went to France. These men are all well-trained and earnest workers, and our association in the work was most pleasant.

The work in the various sections overlapped so that the majority of all of the cases in the hospital were seen in consultation by two or more departments, and the whole hospital staff worked together as one unit. This hearty co-operation and team work added much to the efficiency and pleasure of the work.

The first patients received in the Oto-Laryngological Section were twenty-six ear cases, transferred from the General Hospital, No. 2, on April 1, 1918. The first patients from overseas were received on July 1, 1918. Among these first overseas patients there was a case of bilateral concussion deafness.

This patient was a Lieutenant, who took part in the first attack which the Americans made against the Huns on the Lorraine front in November, 1917. In the advance he was knocked down and stunned by a high explosive shell, but got up almost immediately and went on with his men. A little later a second shell exploded so close to him that he was rendered unconscious by the explosion, and he was picked up and carried back to the First Aid Station. On recovering consciousness he was totally deaf in both ears, and was returned to this country on account of the deafness. In the attack eleven of his men were captured, and he supposed that they had been killed, but a few weeks later he saw the picture of six of his men in a German paper. This picture was later published in this country with the legend that these were the first Americans captured by the Huns. He supposed that the other five men had been killed, but later learned that they had been wounded and were in a hospital when the picture was taken.

A second man in this first group of overseas patients had a facial paralysis, with complete deafness in the left ear due to a fracture of the skull. This man, also an officer, had been thrown from his horse in some practice work, and his skull was fractured in the accident. These two ear patients were the first overseas patients received in the Oto-Laryngological Department.

Among the patients received later, there were three more cases of deafness due to fracture of the skull, from accidental injuries. One man was sleeping on a haymow and while walking in his sleep fell about fifteen feet, striking on his head and causing a fracture at the base, followed by deafness in the right ear.

Another man was driving a truck at night, and in crossing a bridge the truck went over the side of the bridge into the river. The driver of a second truck, following closely in the rear, heard the crash, stopped his truck and sprang into the river to rescue the first man, who was struggling frantically and nearly drowned when the second man reached him. The drowning man grasped his rescuer and both were sinking

when the second man seized a piece of floating wood and struck his companion over the head, rendering him unconscious. He then swam to the shore, dragging the unconscious man with him. The blow over the head in this case produced a fracture at the base on the left side, and an infection in the left ear. This infection, fortunately, did not involve the meninges, and the man recovered. The deafness in the ear, however, was permanent.

In the third case, the soldier came in to the mess room while intoxicated, and attacked the mess sergeant, who in self-defense grabbed a piece of fire wood and struck his assailant over the head, producing a bilateral fracture at the base, with deafness in both ears.

Another ear patient, named W., received in one of the groups of men coming in later, was on the Ticonderoga, eight days out from New York, when she was torpedoed and sunk by a Hun U-boat. She was a merchant ship with very limited berth capacity, and for this reason there were only about one hundred and twenty soldiers on board. Her crew consisted of sixty men. Only twenty-one of the total number escaped. The first shot from the U-boat struck the Ticonderoga in the bow and the forward gun was put out of commission, and all of the gun crew were killed. When W came on deck he discovered that the shells were coming over about four feet above the level of the deck, so he dropped on his hands and knees and began to crawl aft. While in this position a shell struck immediately under him, causing concussion deafness in the right ear. The ship was set on fire by one of the shells, and as the U-boat disappeared the pumps were started and the fire extinguished. The U-boat soon returned and shelled them again, and fired two torpedoes; both of them hit and the boat began to sink. W. was assigned to one of the lifeboats, and with eighteen others succeeded in launching it and getting aboard. After the Ticonderoga had sunk, the U-boat then shelled the lifeboat, but did not hit it, and a little later came up along side and asked if the captain or any other officers were in the boat. Although three officers were with them they were not recog-

nized ,as they did not have their uniforms on, and the men in the boat denied having any officers present. The U-boat then abandoned them in mid-ocean. Two other men were picked up in the water, and they all drifted for four days and three nights. During this time two men, who had been wounded, died and were buried at sea. The survivors were then picked up by an English vessel bound for America, and two days later transferred to an American transport which landed them in New York.

The total number of Otological patients which we received from overseas from July 1, 1918, to March 1, 1919, was two hundred and eighty-three.

Thirteen cases of wounds in the mastoid region.

Two cases of wounds of the auricle only.

Fourteen cases of Otitis Media Suppurative Acute.

Three cases of Otitis Media Catarrhal Acute.

One hundred and forty-one cases of Otitis Media Suppurative Chronic.

Fifty-five cases of Otitis Interna, due to concussion.

Two cases of Otitis Interna following meningitis.

Twenty-three cases of mastoiditis.

The wounds around the mastoid region were caused by pieces of high explosive shell, or shrapnel, or hand grenades, or bullets. The size of the pieces of shell varied greatly. Many of them were small pieces imbedded in the soft tissue and the bony structures also. Some pieces were about a centimeter square. The largest piece which we saw was ten centimeters long; irregularly rectangular in shape and about one centimeter in diameter. This piece struck the soldier about the middle of the mastoid, penetrated the mastoid and middle ear and stopped at the articulation of the jaw. This piece was, of course, immediately removed at the casualty clearing station; tied up in a piece of gauze and sent along with the patient, as he, like all other men who were injured, wanted to keep the piece which hit them.

When he arrived at No. 11 there was a depressed scar over the right mastoid, with some unhealthy granulation tissue in the depression. There was also a facial paralysis

on the right side, and the auditory canal was almost completely closed by scar tissue, so that it was impossible to secure any view in the canal. The hearing in this ear was destroyed. The labyrinthine reactions in both ears were nearly normal. Captain Berry operated upon this man, and found that nearly all of the mastoid cells had been destroyed, but the sinus, fortunately, had not been injured. The posterior canal wall had been crushed and pushed forward, and the facial canal, below the horizontal semicircular, had been partly uncovered by the injury. The stapes was in its normal position, but the other ossicles had been destroyed. The pieces of fractured bone were all removed, and the unhealthy granulation tissue. A plastic operation was done on the membranous canal to relieve the constriction, and the wound was closed, the same as in a radical mastoid operation. The facial paralysis improved considerably following the operation, and the mastoid cavity healed quickly.

In practically all of the cases which were wounded in the mastoid region, the shell fragments penetrated the mastoid, destroying more or less completely the external auditory canal and injuring the facial nerve. All of these cases were deaf in the injured ear, due either to partial destruction of the cochlea, or to concussion. Most of these cases of facial paralysis recovered almost completely when the foreign body and the splinters of fractured bone were removed, thus relieving the compression and irritation of the facial nerve. In all cases of facial paralysis the paralysis was treated with electricity and massage, and in our judgment this treatment hastened the recovery. In all of these cases we did what amounted to a radical mastoid operation, to enable us to remove the foreign body and re-established the auditory canal.

We had two cases of gunshot wounds of the auricle only, with synechia causing occlusion of the auditory canal. These conditions were rectified by plastic operations on the auricle and the canal. In both of these cases the hearing in the injured ear was nearly normal.

Most of the cases of injury of the ear and mastoid region were due to primary wounds in this region. We had, how-

ever, a few cases in which a machine gun bullet entered some other part of the head and went out through the mastoid. One man was struck by a machine gun bullet, which entered the nose at the junction of the right ala with the cheek, passed through both nasal fossae, the articulation of the left jaw and out through the left auditory canal and mastoid. This injury caused synechia in both nasal fossae, deafness in the left ear, left-sided facial paralysis, and an infection in the articulation of the jaw. When he was admitted to No. 11, the abscess at the angle of the jaw was discharging through the auditory canal. All of these conditions improved very materially under appropriate operative treatment, except the deafness, which remained stationary.

About two-thirds of the one hundred and forty-one cases of otitis media suppurative chronic existed prior to military service. These ears were either not discharging when the men enlisted, or the amount of discharge was so slight that the men themselves considered them healed and said that their ears were normal. The unavoidable exposure accompanying life in the trenches almost invariably caused reinfection in these damaged ears, and as soon as the chronic discharge was discovered the men were returned to this country. Many of them did some good work over there before they reported at sick call and were sent back. One third of the chronic suppurative cases developed in line of duty, following exposure in the camps or trenches.

We used various methods of treatment for the chronic suppurative cases. The method which gave us the best results consisted in carefully cleaning the ear with little pledgets of cotton and then applying, on a pledget of cotton, one or two per cent. oily solution of Dichloramin T. Treated in this way the suppuration in the ears, in most of these cases, ceased and the hearing improved.

There were thirty cases of bilateral deafness, due to concussion from exploding shells. In some of these cases the drum membranes were ruptured by the concussion, but in many of them there was, at least, no evidence, and no history, of ruptured membranes. The few cases, which were

not rendered unconscious by the concussion, described it as a tremendous explosion with the sensation of being struck by some flying object. In these cases the labyrinthine reactions were all diminished, but not absolutely destroyed, and the deafness which was complete immediately after the concussion, almost invariably improved somewhat, so that the men could hear a loud voice from one or two feet and were able to hear their own voice and modulate it, and avoid the monotone which is present in congenital deafness. Two cases of deafness following meningitis, showed no improvement in hearing while they were under our observation.

We had one case of meningitis of otitic origin develop in the hospital. This man had had a chronic suppuration in both ears for about twenty years, and showed signs of meningeal irritation soon after he was admitted to the hospital. The symptoms seemed to indicate that the infection originated in the right ear, and I did a radical mastoid on the right side. Following the operation the symptoms of meningitis improved for several days, and then became more pronounced, and I operated a second time, exposed the dura, and carefully searched for the channel of infection, but could not find it. The patient died a few days later, and the autopsy revealed a basilar meningitis, which the pathologist said had existed for some time. It was quiescent when he entered the hospital, but evidently became active while he was under our observation. At the autopsy it was impossible to tell which ear had been the source of infection.

We also had one case of sinus thrombosis, secondary to an acute infection in the ear. This case was operated, the sinus ligated and opened, and the patient recovered.

We had eleven cases of acute mastoiditis, and twelve cases of chronic mastoiditis, due to chronic suppuration in the ear, which we operated upon. Excluding the cases in which we operated, on account of foreign bodies and injuries of the mastoid, and the plastic operation, the number of mastoid operations was comparatively small.

The major plastic operations in our department were either done by Lt. Col. V. P. Blair, who was at the head of all of the Oro-Plastic Surgery in this country, or under his direction by our staff. We all admired his skill and ingenuity in correcting the deformities of the auricle and surrounding parts, and enjoyed immensely our work with him. In a few cases, in which there was no available tissue for plastic work, a prosthesis was made by an artist who was one of the hospital staff. All of the patients preferred to have a plastic operation, if possible, rather than be fitted with any artificial device.

We had only two cases of hysterical deafness, both of which recovered. In each case we decided that the deafness was hysterical by talking to the patient in a low voice while we were conducting the rotation tests. Rather naturally their attention was so diverted by the turning test that they forgot about their deafness and the hysterical element was evident.

The total number of cases of bilateral deafness in the American Expeditionary Forces, up to March 1, 1919, was one hundred and six, and they were all sent to Hospital No. 11. About thirty percent. were cases of concussion deafness from shell explosions. Two per cent. were due to cerebro-spinal meningitis. The remaining sixty-eight per cent. were due to chronic bilateral suppuration.

All of the deaf patients were given instruction in lip reading. The Section of Defects of Hearing and Speech was under the direction of Col. Charles W. Richardson, of Washington, and he secured for this work, eleven of the most capable lip reading teachers that could be found in this country. These women, like most of the men who went into the service from civil life, made decided sacrifices to enter the service, and their skill and loyal work deserves the highest commendation. Each man received individual instruction, beginning with a period of forty-five minutes daily, and then increasing the periods so that each man met his teachers two or three times a day. Under this system of concentrated teaching the majority of these men made

wonderful progress, and in from six to eight weeks many of them became very expert lip readers, so that in conversing with them one scarcely realized that they were deaf. A few of them became so expert that they could read the lips in the moonlight. These deaf patients were invariably very much depressed when they entered the hospital, but as they became able to read the lips their whole attitude changed. They would begin to associate with their companions, and join in the games, and they realized that their deafness was much less of a handicap than they had at first considered it to be. Instead of being dejected and more or less morose they became practically normal individuals, and it was a constant source of pleasure to see these men develop.

One of these lip reading patients was a captain, who had been in the regular army for about fifteen years, and his ideas about the war were interesting to me. One day just after the armistice had been signed I said to him, "Well, Captain, I suppose you are glad that the war is over", and he replied, "Yes, but it was a hell of a fine war while it lasted." Most of us do not agree with him.

All of our work at the Hospital for Head Surgery was interesting. The unusual character of much of the work and the hearty spirit of cooperation in all of the departments made the work a source of pleasure and profit for all of the staff.

Summary: The U. S. A. General Hospital for Head Surgery received its first patients on April 1, 1918. The first patients from over-seas were received on July 1, 1918. The total number of over-seas Otological patients received between July 1, 1918 and March 1, 1919, was two hundred and eighty-three, divided as follows: Thirteen cases of wounds in the mastoid region; two cases of wounds of the auricle only; fourteen cases of Otitis Media Suppurative Acute; three cases of Otitis Media Catarrhal Acute; one hundred and forty-one cases of Otitis Media Suppurative Chronic; fifty-five cases of Otitis Media Catarrhal Chronic; thirty cases of Otitis Interna, due to concussion; two cases of Otitis Interna following meningitis.

Two-thirds of the cases of Otitis Media Suppurative Chronic existed prior to military service. One-third of the Chronic Suppurative cases developed in the line of duty. The total number of cases of bilateral deafness was one hundred and six. Thirty per cent. of these were cases of concussion deafness. All of the deaf patients were given instruction in lip reading. Excluding the operative work on account of foreign bodies, injuries of mastoid and plastic operations, there were eleven cases of acute mastoiditis and twelve cases of chronic mastoiditis which were operated upon.

Discussion.

Dr. James F. McKernon, New York City, asked if many cases of complete deafness had been returned in the early days of the war with epidemic cerebrospinal meningitis as the etiological factor.

Dr. Richardson, in closing the discussion, demonstrated the method of re-education in cases of defects of speech and hearing by the presentation of patients.

Replying to Dr. McKernon's question, Dr. Richardson said many cases of epidemic cerebrospinal meningitis had been returned in the early days, and this condition had been found to be the cause of total deafness in a large percentage of the cases. Mumps, fracture of the skull, with complete destruction of the labyrinth, chronic catarrh and chronic suppuration, were also etiologic factors in cases of total deafness returned.

Dr. Ingersoll, in closing the discussion, noted the interesting fact that nearly all cases of concussion deafness recovered their hearing sufficiently to hear loud voices at one or two feet. The great value of this to the patient was, that he could hear his own voice and could modulate it. The meningitis cases were practically all totally deaf, and showed little or no tendency to recover.

A BRIEF REPORT OF THE ACTIVITIES OF THE DEPARTMENT OF OTO-LARYNGOLOGY OF THE AMERICAN EXPEDITIONARY FORCES, FRANCE.

By JAMES F. McKERNON, Senior Consultant, Ear, Nose and Throat Surgery, American Expeditionary Forces.

In presenting to you a brief history of the activities of the Oto-Laryngological Department of the American Expeditionary Forces, I can perhaps do no better than to give you at first a general outline of what the Department was at the time I was appointed Director and Senior Consultant. At that time it had not arrived at the dignity of the above name, but was known as the Department of Ear, Nose and Throat Surgery, and it was merely an offshoot of the department of general surgery.

The first duty of the Chief Consultant was to list all the Base, Camp, Evacuation, Mobile and Field hospitals and divisional areas thus far established, with their personnel and equipment. Second, to obtain a list of the oto-laryngologists already on duty in France and England and to classify them. Such a list was not available in the Chief Surgeon's office. This necessitated visits to all the various hospitals as well as to the divisional training areas. His third duty was to obtain if possible a classified list of all the oto-laryngologists in American who were available for overseas duty. For this list and for others that followed, the thanks of the Department are due to Colonel Parker, and to Lieutenant Colonel Mosher of the Surgeon General's office.

The inspection of hospitals showed that when the Senior Consultant was given charge of the Department there were seventeen Base Hospitals actively functioning, with only one oto-laryngologist on duty in each. There were already fifty Camp Hospitals established, thirty of which were not functioning. Only ten of those actively functioning had an oto-laryngologist assigned to them. The total roster of officers doing ear, nose and throat work for the American Expedi-

tionary Forces at this time was thirty-two. Following is a summary of the equipment, or rather the lack of equipment for this work in the hospitals of the American Expeditionary Forces at that time.

Base Hospitals.

One-third of the Base Hospitals operating were lacking in instruments and equipment to adequately care for the patients they were receiving.

Camp Hospitals.

Of those functioning, only two had sufficient instruments and equipment to properly care for cases.

Evacuation Hospitals.

In only one was an oto-laryngologist on duty, with practically no instruments or equipment with which to work.

Mobile Hospitals.

None of those established early had an ear, nose and throat surgeon connected with it.

Field Hospitals.

In none of those functioning was there an oto-laryngologist, or any instruments or equipment for use in this department.

Divisions.

There were six oto-laryngologists on duty with various Divisions. Later the number was increased as requisitions were made, but at no time during activities were there sufficient officers from this department to meet the demands made upon it.

From the above summary it will be seen that in reality there existed no ear, nose and throat department except the service in the seventeen Base Hospitals, and in those there was no uniformity of standard as to the work performed. This lack of available men on the ground, coupled with the fact that only a small number were occasionally landing in France and England, handicapped very much the early activities of the Department. It was found also that while there was an ear, nose and throat man assigned to each of the Base Hospitals, he was supposed to remain there, and for the first six months this ruling held good, even though in

many instances two or more men were assigned to the same hospital; and even though some of these hospitals were not actively functioning at the time, their Commanding Officers with few exceptions, would not allow the officer an assignment for temporary duty elsewhere.

By May however, we succeeded in obtaining competent men from many of the Base Hospitals, replacing them for the time being with men who were arriving, or with men who had been tried out on front line work and were found more suitable for Base Hospital work. With these men obtained, and with others who were arriving from time to time, all of our Evacuation and Field Hospitals at that time were manned, and the remainder assigned to divisional work.

Before an oto-laryngologist was assigned to duty with the divisions, it was not unusual to have from 250 to 400 men report sick each morning to the Divisional Surgeon. At least one-half of these cases were suffering from colds and minor complications resulting therefrom. The usual mode of procedure at that time was to send these men to some Base Hospital in the rear, where they were treated for a few days, and then sent to a replacement depot where they were held from three to six weeks and then finally returned to their organization. As soon as an oto-laryngologist was assigned to duty with these divisions, an Infirmary or Dispensary was constructed, and at least 50% of the men presenting themselves for morning sick call with colds and their sequellae, were treated and returned to duty the same day. Of the remaining 50% about 40% remained in the Infirmary and received treatment for from one to three days, and were then returned to duty with their organizations, thereby saving transportation and loss of man power, both of which at that time we were sadly in need of. The remaining 10% it was found necessary to route to Base Hospitals, where they received the more protracted care and treatment needed.

This system was first put into practice by this Department, was later adopted by the Divisions by every depart-

ment of medicine and surgery, and net result being a conservation of man power when most needed as well as a welcome relief to an already over-congested transportation service. While some of the Base Hospitals were well equipped with instruments and supplies, the majority were not, and this was especially true of those that came over during the summer and autumn. Many of these upon landing had no instruments or equipment whatever with which to function, the result being that much valuable time was lost to the service at a period when every hospital and men was sadly needed.

Our Medical Supply Depots at no time carried sufficient instruments and supplies to properly equip a hospital in an emergency, and those instruments they did supply for our Department were so few in number and so antiquated that had it not been for the fact that many of the medical officers brought their own instruments, hundreds of cases could not have received treatment at all, for with the exception of buying an instrument here and there that had been discarded by the French during the earlier part of the war, none could be obtained in France. Later however, this scarcity of instruments and supplies was not such an acute problem, although this supply was always inadequate to the demand.

Hospital Centers.

Where several Base Hospitals were established at one place a set of buildings was assigned to this department, so that all the work in the center was segregated. Special wards and operating rooms were arranged, and examination and treatment rooms for ambulatory patients fitted up, and a staff formed composed of officers from the Units of the Center. This obviated duplication of instruments and equipment, and resulted in better care for the patient besides allowing the excess officers in the department to be made available for duty elsewhere.

Center Consultants.

In all the large Hospital Centers a Consultant was appointed whose duty it was to have a general supervision

over the work of the center and act as Consultant when called upon by the Center Staff or the individual Units. This arrangement proved most satisfactory, resulting in a better care for the patient besides maintaining a more rigid discipline for the Staffs of the Center.

Among the duties of the Senior Consultant was that of visiting all the Base Hospitals as frequently as possible, seeing cases in consultation and operating when necessary and consulting as to the needs of the service with both the Attending Surgeon of the Department and the Commanding Officer of the Hospital. During activities visits were constantly made from one Evacuation, Mobile and Field Hospital to another, seeing cases in consultation and advising as to the proper care and routing of the cases, and later following up these cases that had been routed to Base Hospitals in the rear, and consulting as the nature and amount of reparative work to be done.

Care and Treatment.

Upon a request from the Chief Surgeon, a circular dealing with the care and treatment of cases in this department was prepared and sent to all hospitals in the American Expeditionary Forces, as many cases were being hospitalized unnecessarily for minor operative work. Upon receipt of this circular much of this unnecessary work ceased.

Classification and Standardization.

A working schedule for the classification and standardization of ear cases was submitted to the Chief Surgeon, believing that it would simplify the work in this Department as well as aid the disability Boards in classifying the cases that must come before them.

Routing.

When possible, all cases requiring immediate special reparative work were routed to hospitals in the advance zone where this type of work could be best cared for and frequent observations made. Those cases that could be transported longer distances were routed to Base Hospital No.

115 where a special staff of officers for reparative work was located.

Records.

The ordinary history sheet used in the Army was all that was required, but in many instances this was supplemented by a more complete history from a specialistic standpoint. All officers in the Department were urged to obtain and keep complete records in full and maintain a standard of uniformity. As Consultant I was frequently asked by both regular and reserve officers what need there was for an oto-laryngologist being assigned to an Evacuation, Mobile or Field Hospital. At first my answer was "to care intelligently for cases in his Department." Later experience modified my views on this subject very much. I now believe the need of an oto-laryngologist in an Evacuation, Mobile or Field Hospital is a limited one, owing to the fact that there are but few wounds that would naturally come within the province of the surgeon in this Department that are not multiple, the majority of which concern the general surgeon only. For this reason, especially when there are only a limited number of men available, it is unnecessary to assign a man from this Department for duty at one of these points unless he has had a general surgical training that fits him to act as a member of a team doing general surgery. If a member of such a team can act in a general surgical capacity in addition to caring for those cases that by right belong to his Department, in such a way only can an oto-laryngologist be utilized to a maximum at these points. To assign and maintain one in the front area for this purpose alone would be wasting his time, as his services are more urgently needed in the Base Hospitals of the advanced zone and in large hospital centers where the special cases are collected. At these places the oto-laryngological surgeon is needed, where his judgment and skill can be utilized in caring for the acute conditions that present themselves, and for the reconstructive work that will follow on these cases that are to be salvaged for future line duty.

The cardinal principle of front line work in our Department was following the example of the general surgeon, a debridement of the traumatized tissue and removal of all loose bone splinters and foreign bodies, when present. Through and through penetrating wounds were closed primarily. In all cases where wounds were open and there was a tendency to contraction with increased separation of the edges, a primary suture was done in order to obtain a better cosmetic result for the future reconstruction work that was to follow. In penetrating wounds of the outer and superior wall of the antrum no matter how produced, counter drainage was instituted from below. In bullet and shell wounds of the nose where the bones were shattered, debridement followed by the removal of the loose splinters was the rule, but in no instance was there removal of any piece of bone where there was still an attachment of periosteum. These pieces were approximated as accurately as possible and held in place by some mechanical device so as to allow of nature's repair. In this way much bony structure of the nose was preserved, so that the reconstruction work could be made easier and the future result obtained more satisfactory.

All shell and bullet wounds of the auricle were treated by primary suture. Impacted shell fragments in the external auditory canal were removed and the resultant wound treated by the open method in order to promote drainage, and later when necessary, plastic procedures were instituted. In shell and bullet wounds of the mastoid process, removal and open treatment was the rule. In penetrating wounds of the skull in the region of the temporal bone or nasal fossa, a debridement at first was all that was indicated. Later, when the X-ray had localized the foreign body and the patient's condition admitted it, an attempt at removal (which was many times unsuccessful) was made.

In localizing foreign bodies in the brain no instrument gave us as much help by its precision and accuracy as the Hirtz Compass, and later this was used in foreign body cases to the exclusion of all other aids. In no brain case

was it permissible to further mutilate the brain tissue by digital exploration. If the foreign body could not be removed by a continuous flow of warm saline solution or other non-irritating fluid from a syringe, or could not be extracted by aid of forceps, it was let alone, as experience soon taught us that many of the cases recovered by letting the foreign bodies remain in situ. When fractures of the skull occurred all depressed areas of the bone were removed. At first a mistake was made by removing too small an area. Experience taught the error of this, as subsequent hernias were far less liable to occur when a large amount of bone was removed. This is probably due to the fact that a large exposure produces a minimum amount of pressure from within, whereas a small opening makes for a maximum of pressure.

In all wounds of the throat and mouth the principles of general surgery were carried out, always keeping in mind that drainage was an important factor. In reconstruction work of the auricle where the greater portion of it has been destroyed a more satisfactory result was obtained by making casts or moulds, and from these constructing an artificial auricle from what was known as Hemming's Paste, rather than doing a plastic operation. These were easily placed in position and held by spirit cement and made to conform in color to any skin, and could be easily removed and replaced by the patient at any time. Artificial noses were made in the same way. In some of the nasal injuries it was necessary for respiratory as well as cosmetic purposes to loosen all adhesions and elevate them as much as possible by inserting a piece of cartilage or bone to replace in a measure the trauma existing. In many cases it was found advisable to work on these patients in conjunction with dental surgeons, as appliances had to be fitted and incidental details worked out, and much better results were obtained by utilizing the help of one who had been specially trained in devising, making and fitting these appliances. In the reconstruction work that was done, no didactic rules could be laid down as the reparative process depended entirely upon the size, location, shape and condition of the wound and the

amount of tissue available for repair. Much less of the reconstructive surgery was done in France than was at first expected. This was owing to the decision made by the Chief Surgeon to return all soldiers to the United States that could not be made ready for line duty in a period of three to four months or less. This decision was in all probability due to our lack of beds at that time.

In many of the cases that confronted us it was quite as important to decide what should not be done as to say what should be done, and in this respect we learned a great deal from both our French and English colleagues, who, by the experience gained in the past four years were in a measure able to say which cases should be operated upon and which should not. Thirty percent. of the work of the otolaryngologists in France was behind the lines except in the regimental area, and here as well as further back the bulk of it was much the same as that met with in civilian practice and consisted in caring for the acute conditions and their sequellae. During the influenza epidemic the cases where possible were segregated, and all were treated with warm nasopharyngeal irrigations of saline and sodium bicarb three times a day, using from a pint to a pint and a half at each sitting. This was followed by inhalations and the air in the wards was kept as moist as possible. This unquestionably proved beneficial, lessening the cough and diminishing the duration of the attack. All mucous membrane irritations due to gas were treated primarily by local applications of lime water or bicarb of soda. The laryngeal conditions were best controlled by intralaryngeal injections of guaiacol 2%, and camphor and menthol of each 4% in oil.

Considerable criticism was made by some of the men when a circular was distributed through the department relating to tonsils, namely that no tonsils were to be removed except when markedly hypertrophied or diseased, and never during an acute process. This was made necessary by the wholesale removal of tonsils that took place the first few

months and many hundreds of patients were hospitalized unnecessarily until this order was enforced.

Ear Protectors.

At first there were many and various kinds. Later on all were discarded and gave way to the use of cotton waste moistened in oil or vaseline. This simple mechanical protection was sufficient as it prevented concussion and maintained a maximum of hearing when worn. It was easy to insert and always obtainable.

Experience has taught us that all hospitals engaged in the care of the sick and wounded should be completely equipped and have the proper assignment of medical officers and nurses when ready to function; and that when assignments are made from the Ear, Nose and Throat Department to Evacuation, Mobile and Field Hospitals those officers should be qualified to act as members of surgical teams, either as heads or assistants, as ordinarily there are not enough cases requiring special attention to occupy their entire time in these hospitals. There should also be a center of instruction established for officers of limited experience, so that they may be taught the modern methods of caring for battle casualties. One of the principal points brought forcibly to our attention was that in wounds involving the anatomical parts that properly come under this department there was a too extensive debridement of the tissues. In some cases this was carried to such an extent that an immediate reparative process was impossible, owing to a lack of tissue with which to repair, for it should be remembered that in the regions of the ear, nose, throat and face as extensive a debridement is not necessary as in other portions of the body, because of the anatomical difference in the tissues.

Considerable difficulty was experienced in handling men that were assigned to the Department from divisions and other medical organizations. Many of these men would claim to be expert oto-laryngologists and were assigned to this Department because of this claim or because they were doing regimental line work and wished to make a

change, stating that their former training had been entirely along oto-laryngological lines. These men with few exceptions did not know the first rudiments of ear, nose and throat work, and as soon as this fact was established they were transferred to a Casual Medical Camp and subsequently utilized in other capacities.

This brings up an important point for the future consideration of oto-laryngologists, namely that of standardization. Is a man qualified to practice this specialty simply because he claims to be a specialist in this line of work? Or should he pursue a course of study in this specialty at some recognized institution where, after a prescribed course, he be examined both didactically and practically, and if successful in such an examination he be granted a specialistic degree? A man taking such a course at an institution chartered with the power to grant such a degree or diploma, would at once in the eyes of the medical world be looked upon as competent to practice his specialty. If such a standardization were established, the self-styled specialist would in the future (as far as medical support is concerned) be a thing of the past. I feel strongly on this point and speak from experience because of some of the material which this Department was burdened under the guise of specialism.

During mid-summer the calls for consultation work became so frequent that it was impossible to respond to all of them, and the appointment of a Junior Consultant was requested. This request was granted, and Major John B. Rae was appointed and assigned to Headquarters for duty. This appointment was of great help to the Senior Consultant as well as being of the utmost value to the Department, as it made one or other of the Consultants available at all times. During the summer plans were submitted to the Chief Surgeon requesting that one or more schools of instruction be established for officers of limited experience: that this instruction comprise a thorough course on the functional examination of the ear, as well as the routine and operative treatment of nose, throat and ear cases, and that it also include the teaching of reconstructive work in this depart-

ment. Owing to the lack of available teachers it was not considered advisable to grant this request, but we were given a promise of establishing these courses later. The early signing of the armistice however disposed of any further plans the Chief Surgeon may have had toward establishing such a course of instruction.

In some of the Camp Hospitals only one man was needed to cover the service on the eye, ear, nose and throat. In these instances, through the courtesy of Colonel Greenwood, the Senior Consultant in the Eye Department, an exchange of men between the two departments was made. When the armistice was signed there were 238 officers on duty in the department, and twelve additional held in reserve. When the Third Army was ordered to occupy German territory all the hospitals accompanying them were manned by from one to three officers from this Department, in charge of Major Rae as Consultant, and all instruments and equipment for the special work that was to be carried on was placed with the Medical Supply Depots accompanying the army and requisitioned for use as soon as the hospitals were functioning.

From a personal observation of the French and English hospitals where reconstructive head and face surgery was done, I would most strongly urge that in the event of the United States becoming involved in another war, similar hospitals be established, equipped, surgically manned and ready for work prior to the opening of hostilities, and not wait to see whether or not such hospitals were going to be necessary, as we were told to do in the early days of the war. In my opinion it is just as necessary that such hospitals be ready to functionate at the beginning, as it is that we have Base Hospitals, if we expect to do our duty as surgeons to the wounded. Such hospitals established early give to the patients a better functional as well as cosmetic result, inasmuch as it insures the work being done early by competent men who have previously specialized along these lines.

My warmest thanks and appreciation are due General Ireland as Chief Surgeon, and Colonel Keller as Director of Professional Services, for the help and advice given me at all times. It was their cooperation that made it possible to organize and maintain the Department on an efficient basis. To those officers and their associates who had charge of the services in the Base Hospitals, my own, as well as the thanks of the Department are gratefully given. It was due to their loyal support and willingness to work at all times in any capacity, that made the service efficient for the care of our sick and wounded.

Discussion.

Dr. Harris P. Mosher, Boston, Mass., hoped Colonel McKernon's paper would get into the hands of the Regular Army for their thorough reading; he also hoped they would accept and utilize the suggestions made therein. The war stopped too soon from the medical standpoint. In spite of the screeching of the American Eagle, in spite of the belief that Americans had, that America was prepared to do anything, the fact remains the country was unprepared. Specialists who were not capable of doing the work or who were unwilling to work should not have been sent over. Regarding medical supplies, those who had worked in the Surgeon General's Office had sat up many nights trying to furnish them are still wondering where they are. He strongly suspected that they were under tarpaulin somewhere in France. Why did under-trained men get across? Because medical men ranked fifth from the military standpoint. Men, munitions and food were sent over first. There never had been enough trained specialists. It had been hoped that the consultants would have full power, but they never had. In spite of Dr. McKernon's kind words, they never did have full power,—and it was up to the chief medical office A. E. F. men to give them full power. Furthermore, overseas, they were dismissed rather brusquely. It must be granted, however, that it was very difficult for the civilian doctor to get

the military point of view. Perhaps five out of ten kept the civilian point of view from the beginning to the end.

Dr. Thomas J. Harris, New York City, thought the grateful appreciation of the Fellows of the Society, and of oto-laryngologists throughout the country, was due Dr. McKernon for his splendid work on the other side in his capacity of consultant. All were proud to have been represented by him, for in a way credit was reflected upon all by his fine work. The point of the importance of the standardization in the teaching of oto-laryngology was well emphasized. The conclusions drawn by Dr. McKernon from his wide experience overseas, and the recommendations which he made, were exactly in line with the recommendations made by Dr. Mosher before the American Medical Association at its recent meeting. One could not speak too feelingly about the horrible condition of oto-laryngology. It had been the feeling of the Committee on the Teaching of Oto-Laryngology that they wanted to resign or to go ahead and do something. It was because they wanted to do something that they asked to be continued, yet as a committee they could do little. They could make suggestions to the medical colleges, to be turned down, just as they had been turned down in the past. Unless those connected with medical colleges took definite hold of the matter little could be accomplished. The standardization could never be accomplished by legislation. The Committee had asked to have Dr. McKernon's report, Dr. Mosher's remarks before the American Medical Association and Dr. Coakley's presidential address before the American Laryngological Association, and with these it was hoped that perhaps an impression might be made upon the faculties of the medical colleges concerning the importance of standardizing the teaching of oto-laryngology.

Dr. Emil Amberg, Detroit, Mich., suggested that, inasmuch as this subject of standardization had been before special societies before, and that so far nothing had been accomplished, the Societies should hereafter elect no man

to membership who failed to meet the requirements suggested by Dr. McKernon and others.

Dr. Henry O. Reik, Baltimore, Md., expressed appreciation for the splendid work done by the chiefs in organizing the oto-laryngological department. No department in the Surgeon General's Office had worked harder or accomplished more. Most of the speaker's time overseas had been spent in an executive position in the hospital, in which the oto-laryngological department was as well or better taken care of than any other. The equipment was as good as any other, and they had more visits in his hospital center from the oto-laryngological and ophthalmological chiefs than from any others. He especially commended the excellent work of these two chiefs.

REPORT OF CASE OF OTITIS MEDIA, SUPPURATIVE, CHRONIC, RIGHT, MASTOIDITIS, OPERATION FOLLOWED BY MENINGITIS, AND ON POST MORTEM EXAMINATION FINDING OF OLD ABSCESS IN THE TEMPOROSPHENOIDAL LOBE OF THE BRAIN.

By JOSEPH H. BRYAN, M. D., Lieut. Colonel, O. R. C., U. S. Army.
Washington, D. C.

James B. Private Company 5, 2nd Train Engineers, was admitted to the Walter Reed General Hospital, July 25, 1918, complaining of a discharge from the right ear.

Family history good.

History of present disease: Seven years ago had earache followed by discharge from the right ear. This condition cleared up and he remained well until about two months ago.

Objective symptoms: Aside from the purulent discharge from the right ear, there appeared no other essential disturbances. July 9th a small amount of granulation tissue was removed from the external auditory meatus, a swelling which appeared back of the auricle subsided, and the discharge from the canal was more profuse. The ear was ordered douched every 3 hours with hot normal saline solutions, and for several days there was no appreciable diminution in the quantity of secretion from the ear. August 16th, complained of pain in head, frontal and occipital regions, mentality very dull, meningeal involvement suspected, but this opinion was not concurred in by medical consultant. Eye grounds showed nothing abnormal on ophthalmoscopic examinations, pain over mastoid with some swelling.

August 19th, the usual mastoid operation was done, and on removing the cortex of the mastoid the bone was found densely sclerosed. Three distinct foci of pus were found, one near the tip, one in the outer angle, and one forward near the zygomatic cells. All diseased bone was removed and a fairly free opening made into the aditus, the wound dressed

with gauze soaked in a solution of dichloramine T in chlorocosane. The patient was returned to the ward in good condition. August 21st he passed a restless night, complaining of no pain, mentally not clear; temperature 103°. August 22nd, mastoid dressing removed, cavity dry, but large quantity of pus on dressing coming through external auditory canal. Wound further explored but no diseased bone discovered. A large opening was made through the aditus to the middle ear. The dressing re-applied, August 23rd, general condition seems improved and mentally clearer; temperature still elevated. August 26th passed a very restless night complaining of pain in head — referred especially to the frontal and occipital regions. Today he is in a stuporous state—pupils react slightly, spasticity of neck and arms, marked Koenig on left side, patellar reflexes absent, no Babinski present, eyes showed no fundus changes, no choked disc. Lumbar puncture done; fluid found under moderate pressure turbid and streptococcus present. In consultation with the Chiefs of the Medical and Surgical Services, the diagnosis of meningitis was confirmed and it was agreed that no further operative measures were indicated. August 27th the patient died, 1 a. m. The temperature was normal until August 8th, when it rose to 103°, again dropping to normal until August 15th, slowly rising to 103° for the rest of life. The pulse followed the temperature changes, ranging from 76 to 120, 160 at death. Respiration 18 to 30, 50 at death.

Laboratory findings: X-Ray, right mastoid cells obscured. July 27th throat smear, no streptococcus present. August 24th, W.C.C. 20,200. 90% neutrophilia, 10% lymphocytes and transitionals. August 19th, discharge from right ear, yielded streptococcus hemolyticus. August 25th, secretions from mastoid yielded streptococcus hemolyticus.

The following is a report of the autopsy record as far as the brain is concerned.

Diagnosis: (Purulent inflammation of pia arachnoid, mastoiditis, meningitis.)

Specimen is a large fairly well fixed unsectioned brain. Pia mater of the lateral and superior surface of the hemisphere

deeply infiltrated by thick layer of greenish yellow gelatinous purulent exudate. This exudate is especially notable along the superior frontal convolutions and over the frontal lobes where it extends deeply into the sulci. This exudate separates easily from the surfaces of the gyri which are softened and evidence typical superficial cortical encephalitis. The subpial exudate is in some places 4 mm. in thickness, especially over the frontal lobes. The underlying veins are tortuous, congested with dilated lymph sheaths which are infiltrated by pus.

Membranes of the base are not so extensively involved but show moderate amount of thickening, infiltration and congestion, with underlying superficial cortical encephalitis with more extensive necrosis over the tips of the temporal lobes and along the gyri recti.

The membranes about the base of the cerebellum and pons are moderately adherent, matted together, slightly thickened, and contain pus pocket superior to the corpora quadrigemina lying within the valum interpositum and extending laterally into the chroid plexuses of the lateral ventricles, especially on the right side, where it is continuous with an extensive abscess cavity reaching from the tip of the temporal lobe backward through ⅔ the length of the lobe and communicating with both the occipital and the temporal horns of the lateral ventricle, but separate from the anterior end of the temporal horn by a thin lamina of granulation tissue.

The walls of the abscess cavity are composed of soft, purulent granular material, containing occasional blood clots and masses of necrotic brain material. This granular hemorrhagic exudate has involved the ependyma of the above mentioned horns, especially the occipital which presents a dull slimy appearance. The lateral choroid plexuses are infiltrated by yellowish purulent material. The frontal horns of the lateral ventricles and the third ventricle also show an acute purulent ependymitis.

Basal ganglia and internal capsules are moderately hemorrhagic, edematous, and show beginning diffuse inflammatory changes.

Microscopical Examination.

1. Frontal cortex. The overlying membranes show moderate round cell infiltration with a few polymorphonuclear leucocytes about the walls of the blood vessels. The membranes as a whole are only slightly thickened. The deeper cortical vessels and also those of the white substance present greatly thickened and deeply infiltrated walls. This exudate is composed of fibrin, lymphocytes, plasma cells, and polys, involving mainly the tunica adventitia which is closely packed with these cells. The white substance shows notable increase in neuroglia cells and mononuclear wandering types. In the cortex the ganglion cells are somewhat shrunken.

2. Temporal cortex. Sections from the left side show widely dilated perivascular lymph spaces. The pathological changes in general resemble those of the frontal region except that they are somewhat less extensive.

On the right side, sections from the margin of the abscess are filled with pus cells, hemoglobin pigments, mononuclear wandering cells, numerous macrophages and areas of necrotic tissue loaded with cell debris. The polymorphonuclear elements predominate. The cortical structures are obliterated by exudate process. A few new formation capillaries are noted as well as a few strands of organizing fibrous tissue in all sections.

3. Precentral cortex. The blood vessels of the overlying meninges are dilated, filled with blood pigments and an increased number of white elements, and surrounded by numerous mononuclear cells. The meninges in general are only slightly thickened and there are very few superficial cortical changes. The smaller cortical capillaries are especally prominent and a large number of mononuclear cells are noted in all areas. All tissues appear edematous.

4. Cerebellum. Presents an active meningitis with also numerous chronic inflammatory elements accompanying the membranes deeply into the cerebellar fissures. Many of the meningeal vessels show fibrous thickening and some complete occlusion by fibroblasts.

The purkingian cells are reduced in number, the protoplasm is very pale, homogeneously stained. Nissl substance completely absent in some, leaving the nucleolus as the only prominently stained structure. The granular layer is notably reduced in width.

Summary:

1. Acute purulent leptomeningitis, with chronic inflammatory cell infiltration.
2. Large temporal lobe abscess, with necrotic walls.
3. Secondary cerebellar changes.

Noland D. C. Lewis, 1st Lieut. M. C.

Brain.

Brain weighs 1490 grams. There was a considerable amount of turbid fluid beneath the dura. Looking at the base of the brain the pia arachnoid in the region of the pons and medulla and adjacent portions of the cerebellum is very opaque in appearance and between the medulla and both lobes of the cerebellum and extending in between the lobes of the cerebellum in that region is a distinct yellowish deposit. On the extreme outer portion of the left lobe of the cerebellum is a thick yellowish deposit. A thick yellowish deposit is seen at the extreme anterior part of the brain on the anterior face of the frontal lobes. In the fissure between the frontal and temporal lobes the pia arachnoid is distinctly infiltrated with a greenish yellow deposit. There is a distinct sinking in of the tissue of the posterior portion of the temporal lobe as the brain rests on its dorsal aspect and on palpatation the interior of the right temporal lobe is either a pus cavity or a mass of soft necrotic tissue. Looked at from its dorsal aspect the vessels of the brain are all congested as they are on the under aspect and there are very distinct greenish yellow patches of exudate in the pia arachnoid involving the exterior and inner $\frac{1}{3}$ of the frontal lobes. Back of the exudate on the frontal lobe on the left side, there is an irregular area of exudate about 60 mm. in length running along the longitudinal fissure and extending out laterally at its farthest point 40 mm. The exudate dips

down on the mesil aspect of the hemisphere for a distance of about 15 mm. Further out on the left hemisphere is another irregular infiltration on the pia arachnoid of greenish yellow material having a general dimension of about 20x15 mm. On the right side of the brain is a similar exudate in the pia arachnoid but it is only about ½ or ⅓ of the size of the one just described. The whole brain feels unusually soft, probably due to autolytic changes, as the body was kept for 16 hours without being placed on ice.

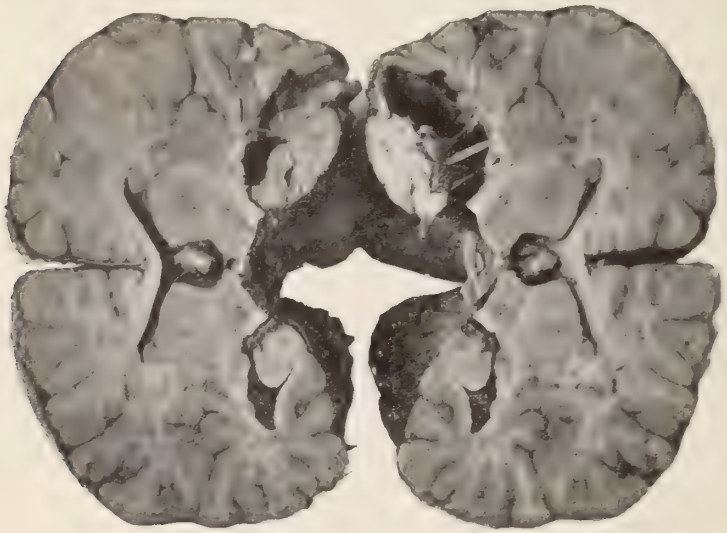


Figure I. A section of the brain showing seat of an extensive abscess in the temporosphenoidal lobe.

Bacteriological Examination.

Cultures from the turbid excess of fluid beneath the dura from the mastoid wound, from the two small loose fragments of bone mentioned above, from the clot in the lateral sinus and from the heart's blood yielded streptococcus hemolyticus.

A section of the temporal bone showed a small necrotic process in the roof of the tympanum, through which possibly the pathological organism may have been transferred to the brain.

The abscess of the brain was probably an old one which gave no evidence of its existence during life. The meningitis was also probably present before operation and was lighted up by the operation on the mastoid.

Discussion.

Dr. Edward B. Dench, New York City, asked if he understood that the dura was exposed in the middle fossa. He also asked if there was any connection between the abscess cavity and the ventricle. It had been his practice to make a preliminary lumbar puncture in every case. There were undoubtedly many cases of latent meningitis which would be lighted up by operation. In such cases there were no symptoms at all. The finding of bacteria in the fluid made the prognosis practically hopeless. He recalled one case in which there was meningococcus infection, but he remembered no case of streptococcus infection in which operation benefited the patient.

Dr. Francis P. Emerson, Boston, Mass., recalled a case in which almost pure hemolytic streptococcus was found in the spinal fluid. This was put into a mouse, and the mouse died in four hours, yet the patient recovered.

Dr. B. Alexander Randall, Philadelphia, Pa., had noted, almost invariably, that there was slowing of the pulse at some time of the day. He always gave the order to have the pulse taken every hour in cases that suggested, by their mental attitude or other signs, the presence of brain abscess, and that any subnormal frequency be rigidly recorded on the chart as well as in the ward-book, where it might be overlooked.

Dr. Norval H. Pierce, Chicago, Ill., wished to put on record a case which had come under his observation recently. The patient, a woman in the late forties, was waiting in the general reception room, having walked in with her two

daughters. She complained of some headache, and of inability to read as well as she had been able to do a month or so previously. The history of otitis media was elicited. Examination of the ear affected revealed slight abnormality of the drum membrane. There was some disturbance of gait. The patient was sent to the hospital with instructions to remain there until he saw her. She refused to go to bed, and when he saw her she was arguing with the attendant as to whether she would stay in the hospital. The next morning he was told over the telephone that there was aphasia, rapid pulse, some choked disc, whereupon he said he would operate in the afternoon. When he arrived at the hospital she was unconscious, there was stertorous breathing, and she was livid; in other words, she was on the point of death. Two hours afterward she died. Post mortem examination showed no involvement of the mastoid cells, but a large acute abscess in the left temporosphenoidal lobe, which had broken into the lateral ventricles. The lateral ventricles were filled with pus. He was glad that he had not operated because death almost invariably occurs in such cases. This is due to the giving way of the thin partition of brain substance separating the abscess from the ventricle at the moment the abscess is evacuated. In such cases the abscess does not break into the ventrical but the latter into the former, in consequence of the decrease of pressure on the part of the abscess, the pressure in the ventrical being suddenly plus.

Dr. James F. McCaw, Watertown, N. Y., recalled a case in which he could see the shiny wall of the lateral ventricle. He operated to remove the pressure, and the patient recovered. This was not an acute case, however.

Dr. Ewing W. Day, Pittsburgh, Pa., was glad to see that Dr. Dench was at last coming to see the importance of doing lumbar puncture. The speaker had advocated it five years or so ago. He was firmly convinced that there were cases of

diffuse meningitis in which it was not suspected that the patient had the disease, while there were cases of circumscribed meningitis which gave no symptoms more than would be ascribed to the mastoid. Nature would successfully take care of these. The possibility of these walled-off abscesses occurring was demonstrated in a case which came under his care at Camp Lee.

Dr. Pierce added that if the abscess had a tough limiting membrane, it could withstand a good deal of pressure, but in acute cases this was not so.

Dr. Bryan, in closing the discussion, replied to Dr. Dench's questions in the affirmative. The abscess cavity and the ventricle were practically continuous. He was convinced before the operation, that the man had meningitis, but it was on account of the insistance of the medical man that he did not do a lumbar puncture. He agreed with Dr. Dench that lumbar puncture should be carried out in every case.

LOCAL ANESTHESIA AND THE MASTOID OPERATION.

By MAX A. GOLDSTEIN, M. D., St. Louis, Mo.

The recent epidemic of Influenza in the Military hospitals of the country has taught us many valuable technical and therapeutic lessons. The constant presence of atmospheric infection, the frequency of active pneumonia, has presented many risks in major operations under protracted anesthesia during this period. This proved to be emphatically the case in a series of acute mastoid empyemas following in the wake of Flu infection.

To overcome the serious objections to the use of general anesthesia, practically all of the operative work in the Section on Head Surgery at Camp Dodge Base Hospital during the active flu period has been accomplished under local anesthetics and the experiences gleaned from this practice in so large a series of cases leads us to discuss this question of local anesthesia as a possible regular and routine procedure.

I desire to report herewith a series of twenty acute mastoidectomies successfully performed by me under local anesthesia in this Service. By successful performance I mean a minimum of pain, a minimum of risk to the patient's health, and one hundred percent. recovery.

The principle on which this form of anesthesia is based is that of diffuse and constant pressure on the nerve distribution in the skin and cellular tissues, as originally developed by Schleich. The Schleich anesthesia is a superficial and deep subcutaneous injection of fluid along or throughout the selected area of operation and depends almost entirely on diffuse pressure on the nerve-end organs, and not on the character or strength of anesthetic used for the same. Anesthesia can be produced by plain sterile water as well as by admixture of cocain, eucain, novocain or other known drugs. In most of the cases of mastoid com-

plication following acute suppurative otitis media during the Flu epidemic, the soft tissues about the mastoid area were infiltrated and edematous beyond the usual intensity. This marked infiltration offered an additional obstacle to the effectiveness of a local anesthesia by subcutaneous method but even this difficulty was overcome by increasing the quantity of solution used, firmer pressure in making the injection and carrying the injecting needle classically subcutaneous for the superficial injections and under the periosteum for the deep injections. By this procedure I was able to maintain an area of uniform pressure between the surface tissues and the periosteum and thereby control all the intermediate nerve elements.

Technique.

For these injections I use a 10 c.c. all-metal syringe and all-metal plunger and a needle two and one-half inches long and of fair lumen. The most satisfactory anesthetizing solution is one-half of one percent. novocain in distilled water to which may be added one to ten thousand solution of adrenalin in equal parts. This solution as well as the cocain solution is rendered thoroughly sterile by boiling in small Erlenmeyer flasks or special porcelain receptacle on Bunsen burner or spirit lamp shortly before operation.

To avoid mistakes in the use of one solution for another it is a general order throughout the hospital to lightly color all cocain solutions with methylene blue, and all novocain solutions intended for tissue injection with tincture Persionis. With a standard hypodermic syringe and needle (either glass or metal) I first make my subcutaneous injection from the zygomatic line and working toward the tip. The infiltration includes a belt of about one inch width and extends from the insertion line of the auricle backwards and in parallel zone. The deep injections are then undertaken with the heavier metal syringe and needle beginning at the same point on the zygomatic line and covering the distance to the mastoid tip at about four points. For the deep injections the larger needle is plunged

in a slanting direction downwards until the point engages the mastoid bone. By a slight rotary motion of the hand the needle is worked between the periost and the bone and 5 or 6 c.c. of fluid contents forced into this area. The same technique is carried out at the other three selected points from the zygomatic line to the mastoid tip and, in the injection at the tip the slant of the needle is directed upward toward the head, instead of downward toward the neck. These two injections, deep and superficial, effect an area of anesthesia throughout the field of operation. The classical incision is now made parallel with the insertion line of the auricle and cutting in one sweep from zygomatic line to the tip, and to the bone.

Before elevating the periosteum forward and backwards, and applying retractors, and after controlling hemorrhage, a suitable pledget of cotton, soaked in ten per cent. solution of sterile cocain is placed in the wound for four or five minutes. The one difficult area to anesthetize during the mastoid operation is the posterior wall of the auditory canal and the middle-ear cavity proper. To accomplish this satisfactorily the large injection needle is passed to the depth of the mastoid incision just made between the periost and the bone and carried to the fundus of the canal as far forward as possible. Two or three c.c. of solution are delivered at this point. If the operation is undertaken simply for mastoid cell exenteration and drainage of the antrum this one injection into the depth of the canal wall will suffice. For the radical operation, further injections are necessary to insure anesthesia of the tympanic membrane and tympanic cavity. This completes the technique for anesthesia and the operation is conducted in the usual manner.

DETAILED CLINICAL RECORD OF TWENTY CASES OF MASTOIDECTOMY UNDER LOCAL ANESTHESIA.

Case I. H. E. W., male, farmer, age 19, Ohio; in service two months, date of admission, Sept. 27, 1918. Temp. 100.6°, pulse 84, resp. 24, headache, epistaxis, cough, pharyngitis, conjunctivitis — diagnosis influenza-ambulatory. Developed measles with profuse eruption Oct. 7; bronchopneumonia Oct. 18.

Oct. 26. Measles cured; convalescing from pneumonia.

Oct. 27. Acute otitis media sup. dextra and within 24 hrs. much sensitiveness over right mastoid area, skin glazed and edematous; considerable viscid pus discharging from right ear; acute, constant earache.

Oct. 29. Mastoidectomy under local anesthesia; 35 c.c. ½ per cent. novocain. Operation painless. Cortex thin; wide area of necrosis and granulation; antrum large; much pus. Laboratory exam. of pus from mastoid reports strept. hemolyt, present. Usual mastoid after treatment. Patient made uneventful recovery; discharged from ward Dec. 31.

Case II. A. B. W., male, farmer, age 23, Iowa; service five months; date of admission, Nov. 30, 1918. Temp. 103°, pulse 120, resp. 24, face flushed, headache, sore throat, profuse eruptions, cough, photophobia.

While on guard duty caught cold; Nov. 30 measles developed; moderate bronchopneumonia found Dec. 12. Acute sup. otitis media sinistra with hemo-purulent discharge began Dec. 19. Pain and tenderness over left mastoid developed Dec. 25; mastoid operation, Dec. 28. 40 c.c. ½ per cent. novocain used; injection quite difficult, due to extent and hardness of induration area. Surprised to find, under these circumstances, the completeness of the anesthesia; much pressure used in making the injections. Laboratory exam. for pus in mastoid reports strept. hemolyt. present.

Jan. 15. Wound healed completely; patient discharged.

Case III. H. McC. W., male, age 30. Date of admission, Oct. 5, with usual symptoms of influenza, accentuated by pain in right ear, later in left ear.

Right M. T. bulging, intensely red, with multiple blebs. Blebs punctured and careful culture from contents showed presence of strept. hemolyt.

M. T. incised 24 hours later with free discharge of pus. Similar condition developed in left ear.

On Oct. 18 tenderness developed over left mastoid with edema, checking up of pus, discharge from ear, rise in temperature, and slight chill. Mastoid exenteration under ½ per cent. novocain local anesthesia; 35 c.c. injected with considerable difficulty, owing to intense induration. Anesthesia complete. Bacteriological examination reports presence of strept. hemolyt.

In this case a slight edema and moderate amount of slough of wound edge was noticeable during first few dressings. This gradually subsided without unusual treatment. Patient made uneventful recovery.

Case IV. H. McC. (same patient as Case III). Mastoid empyemia, right.

Mastoid exenteration undertaken with local anesthesia, ½ per cent. novocain, about 30 c.c. injected. Anesthesia complete. On removing

cortex, bone found very necrotic and all cells full of semi-fluid, sanguinous pus. Bacteriological examination reports presence of strept. hemolyt., healing rapidly. Patient discharged Jan. 6.

Case V. C. J. W., male, age 22. Date of admission, Nov. 9. Convalescing from measles.

Nov. 10. Acute sup. otitis media, right.

Nov. 12. Acute bronchitis, coarse rales heard throughout right lung; frequent cough; no physical signs of pneumonia.

Nov. 14. Chest findings negative. Acute laryngitis; cough persists.

Nov. 16. Sore throat, pain in right ear.

Nov. 18. Ear discharging freely.

Nov. 25. Pain in ear continues. External auditory meatus swells; tenderness over mastoid.

Dec. 15. Mastoid tenderness increasing.

Dec. 21. Mastoid exenteration; operation under local anesthesia of cocain-novocain.

In this case edema infiltration of wound areas were very intense, and much pressure was necessary to deliver the contents of the anesthetizing syringe at selected points. 50 c.c. of cocain-novocain were injected. Special stress was laid on the introduction of the injecting needle between the periost and mastoid bone.

Mastoid and antrum contained much bloody pus and granulation tissue. Strept. hemolyt. found from cureted tissue in mastoid.

Wound healed promptly and satisfactorily. Swelling in external auditory canal disappeared within 24 hours after infiltration anesthesia. No slough in wound area; no pain at operation, no shock.

Case VI. J. I., Ind., male, age 29. Admitted from "flu" pneumonia ward, convalescing from severe shock of bilateral pneumonia.

Nov. 9. Earache and mastoid tenderness. Patient gives history of previous acute sup. otitis media in both ears about nine years ago; this condition cleared up in two or three weeks and has had no trouble with ears since.

Nov. 11. Mastoid pain aggravated; intense general cephalgia, temp. 100.6°; some vertigo.

Nov. 12. Mastoid operation. Exenteration of left antrum and cells under cocain-novocain anesthesia.

Infiltration quantity, 60 c.c. Injection limited to mastoid area and not introduced in external auditory canal.

Patient complained of no pain during operation, but describes extreme discomfort in sensation of mallet and chisel.

Report on curetted mass indicates presence of strept. hemolyt.

In this case there seemed to be some operation shock during ten or twelve hours following operation. After that convalescence was rapid and simple.

Case VII. E. R. W., male, age 27. Contracted measles Nov. 18. Discharged from infectious ward on Nov. 27. Developed ear ache Dec. 1. Admitted to Head Surgery, Dec. 3. Ear discharging freely; mastoid tenderness and infiltration persisted until Dec. 20, when mastoid exenteration under local anesthesia was performed. Radiogram also corroborated presence of pus in mastoid antrum and cells. Did not localize cloudiness or shadows in tip.

Infiltration anesthesia with 50 c.c. cocain-novocain. Superficial injections accompanied by some pain. No complaint of tip injections. After infiltration was complete no further complaint from patient.

Bacteriologically strept. hemolyt. and staph. albus were found. Pus in antrum and upper cells; blood and slight granulations in tip cells. Entire cell labyrinth was exenterated.

Patient walked from the operating table to roller chair. Wound healed promptly and completely.

Case VIII. C. W. W., female, A. N. C., age 29. Admitted Oct. 26, sore throat, ear ache. Ear discharging. Tem. 101°. General depression, some cough.

On inspection M. T. found diffusely injected and red, with multiple hemorrhagic blebs. Free incision made to facilitate better drainage. Discharge of bloody pus continued for a period of several weeks. Temp. fluctuating between 97.8° and 102.5°.

Nov. 10. Moderate mitral regurgitation noted. No appetite; no food assimilation; bowels require constant attention; patient assuming intense general irritability and nervousness. Superior posterior canal sagging.

Dec. 27. Right mastoid cells and antrum exenterated under local anesthesia. In this case the extreme general nervous condition of the patient and her distrust of any surgical attention seriously handicapped the local anesthesia. The resistance and restlessness demonstrated at the time of operation must be largely attributed, in this case, to the mental attitude and fear on the part of the patient rather than to any ineffectiveness of the anesthetizing injections.

Patient recovered quickly, wound healing rather more rapidly than usual, and this also may be noted, as there was quite marked disturbance of circulation during the active period of her illness.

Bacteriologically, strept. hemolyt. found in mastoid wound.

Case IX. L. K. W., male, age 22. Bilateral lobular pneumonia following "flu". Admitted to Head Surgery Dept. Oct. 2. Left drum membrane ruptured spontaneously following ear ache of three or four hours; discharge of blood and pus from ear followed.

Oct. 21. Paracentesis was required as discharge was arrested, and pain and fever continued.

Nov. 25. Extreme mastoid tenderness; pain in ear, patient slightly delirious.

Nov. 27. Left mastoid operated. Cells exenterated under local anesthesia. 50 c.c. cocain-novocain used. Anesthesia complete; patient walked from operating table to roller chair. Uneventful recovery.

Case X. W. P. N., male, age 27. Patient admitted from "flu" pneumonia ward. Convalescent from bilateral lobular pneumonia. Acute sup. O. M., right, began during "flu" pneumonia attack, and was treated by consultant regularly during this period. After admission to this Dept. ear symptoms became aggravated. Tenderness over mastoid developed; discharge became scant; rise in temperature daily of from one to two degrees.

Nov. 29. Operation of right mastoid; exenteration by local anesthesia. 40 c.c. of cocain-novocain used; infiltration was prompt; anesthesia complete, even to the extent of probing from the antrum to the cavum tymp.

In this case there was some slight slough of the wound edge, but this could hardly be attributable to the infiltration process, as less quantity than usual of anesthesia fluid was used, and there was but little induration over the mastoid area and not much pressure of injecting syringe required. Patient healed promptly.

Case XI. A. W. W., male, age 23. Influenza, admitted Oct. 7; temp. 100.2°; pharyngitis and tonsilitis, headache, dizzy, cough.

Oct. 12. Confluent lobular pneumonia.

Nov. 4. Throat red, right fossae swollen, pain in right ear, tenderness over mastoid.

Nov. 6. Purulent discharge from right ear; tenderness over mastoid less; tonsils less red but still somewhat edematous.

Nov. 11. Severe pain in mastoid region, discharge from middle ear still continues; ear ache fairly constant. Admitted to Head Surgery section.

Nov. 17. Operation; exenteration of right mastoid cells, local anesthesia, cocain-novocain. 50 c.c. of infiltration fluid used. Anesthesia complete, patient complained of no pain. Walked from table to wheel chair. Sitting up six hours after operation; ambulatory three days after operation. Complete bacteriological confirmation of strept. hemolyt. from pus in mastoid taken at operation.

Case XII. C. O. W., male, age 22. Patient admitted to hospital on stretcher; severe "flu," all characteristic symptoms, left lobular pneumonia, lower lobe. Two weeks after admission developed acute otitis media, hemorrhagic, left; paracentesis; free sero-hemo-purulent discharge.

In this case strept. hemolyt, was determined by bacteriological examination of pus discharged from ear. Characteristic mastoid symp-

toms developed and patient was operated Dec. 1. Edema and induration over mastoid was marked, and anesthesia was accomplished with 60 c.c. of cocain-novocain solution only after considerable pressure of syringe and by using much care in getting under periost. Anesthesia complete; patient walked from operating table to chair. Recovery uneventful. Bacteriological confirmation of strept. hemolyt. from curetted mastoid tissue.

Case XIII. A. S. W., male, age 23. Admitted to "flu" ward with characteristic "flu" symptoms accentuated by intense ear ache. Inspection of right M. T. reveals multiple hemorrhagic blebs. These were incised; bacteriological culture of serum from blebs diagnosed as strept. hemolyt. Moderate ear ache continued for several days; M. T. bulging on fourth day and paracentesis performed. Thirty-six hours later mastoid tender to touch, edematous and posterior superior canal wall sagging. Pain on pressure over mastoid accentuated at tip.

Nov. 7. Mastoidectomy by local anesthesia; 50 c.c. cocain-novocain used; anesthesia complete; cells exenterated to tip; outer table at tip found necrosed; typical Bezold mastoiditis. This was corroborated by radiogram before operation. Bacteriological findings of pus from mastoid indicate strept. hemolyt. Patient ambulatory throughout. Recovery uneventful.

Case XIV. E. O. W., male, age 21. Acute otitis media suppurative preceded "flu" infection about two weeks. Patient was operated in 1904 for mastoid empyema of left ear.

Convalescent from "flu" within five or six days, but pain and discharge in ear accentuated. Mastoid tenderness and edema developed; mastoidectomy performed Dec. 25. Exenteration of cells under local anesthesia, cocain-novocain in 50 c.c. quantity used as infiltration fluid. Anesthesia complete, patient ambulatory throughout. Bacteriological findings—strept. hemolyt. and staph. albus.

Case XV. S. P. W., male, age 28. Admitted with usual "flu" symptoms; developed lobular pneumonia, bilateral; three weeks after convalescence from pneumonia mastoid area becoming suddenly edematous and tender; fever 101.6°; intense headache and some vertigo.

In this case there was no discharge from the ear, and no change in color, plane, or surface appearance in M. T., and no evidence of fluid in tympanic cavity.

Dec. 2. Mastoidectomy under local anesthesia, cocain-novocain 50 c.c. Patient walked in and out of the operating room; anesthesia complete; recovery complete. Bacteriological findings of granulation tissue, blood, and slight quantity of pus found in mastoid cells reported strept. hemolyt.

Case XVI. T. L. W., female, age 25. Apparent recovery from "flu" and pneumonia, but patient still weak and prostrated. Pulse thready

and slight intermittent heart. This case was one of blood transfusion.

Right mastoid became involved three days after an acute otitis media following apparent coryza.

Patient taken to operating room on roller stretcher. 40 c.c. of cocain-novocain injected. Anesthesia ideal; considerable pus and blood found in antrum; mastoid cells small and entire mastoid area quite sclerotic. Bacteriological findings, strept. hemolyt.; recovery uneventful.

Case XVII. J. C. M., male, age 25. Admitted as stretcher case with severe "flu", of which profuse epistaxis was a predominant symptom. Culture of blood from nose at time of hemorrhage showed presence of strept. hemolyt. Acute otitis media with hemorrhagic blebs mastoiditis developed within three days.

Mastoidectomy under local anesthesia; 40 c.c. of cocain-novocain solution used; bone found quite sclerotic, small antrum; comparatively little pus. Bacteriological findings from curetted tissue, strept. hemolyt. Anesthesia complete; recovery complete.

Case XVIII. L. M. W., male, age 67. Convalescent from measles and pneumonia. Suppurative otitis media, left, persisting for about four weeks. Pain in mastoid region developed gradually but persistently.

Mastoid operation under local anesthesia, 50 c.c. of cocain-novocain used, anesthesia quite satisfactory; cell labyrinth filled with granulation tissue and small quantity of pus, and was exenterated to tip. Slight edema about edges of wound for several days; this subsided uneventfully; patient made complete recovery.

Case XIX. J. McC. W., male, age 7. Admitted from civilian quarters following convalescence from bilateral lobular pneumonia. Typical acute mastoid empyema with usual symptoms. 40 c.c. of cocain-novocain injected; anesthesia complete. This was an exemplary patient. Felt simply the discomfort of the malleting but no pain. Strept. hemolyt. found in pus of exenterated mastoid area. Recovery complete.

Case XX. J. F. W., male, age 24. This patient had a severe lymphadenitis on the right side of neck following "flu" and lobular pneumonia. Neck gland seemed to gradually clear up, but mastoid infiltration ensued, and the radiogram showed definite haziness in mastoid antrum and cells adjoining antrum. No discharge from ear noted at any time, and no evidence of involvement of middle ear cavity by usual methods of inspection and examination.

Mastoid exenteration done under local anesthesia, 50 c.c. cocain-novocain used; exenteration performed as completely as possible down to cells in tip. Strept. hemolyt. corroborated in bacteriological findings of tissue from operated field; some bacteriological diagnosis had been made from broken down cervical glands which had been incised, curetted, and drained about three weeks previously. Patient made satisfactory recovery.

In the twenty cases here reported, my observations included the completeness of the anesthesia, the conduct of the patient, the character of the invasion, the intensity of the process, the size of the wound, and such other data as may help to throw light on this form of technique.

ACUTE MASTOIDITIS; A CLINICAL STUDY BASED ON CASES SEEN IN THE OTO-LARYNGOLOGICAL SERVICE, U. S. GENERAL HOSPITAL 14, FORT OGLETHORPE, GA.

By THOMAS J. HARRIS, LIEUTENANT COLONEL M. R. C., U. S. A.

Acute affections of the middle ear were a frequent occurrence at all the army camps during the year of 1918. Several excellent reports have been made regarding them including one by Major Lathrop at Camp Shelby, Miss., and another by Major Scott, and others at Fort Riley. There can be no question that they are correct in ascribing them to the close association of large bodies of men under unusual conditions and in the virulence of the infection. The camps situated in Chickamauga Park, Georgia, were no exception to this. It is probably true that no great differences in the clinical picture existed in the cases coming from them to U. S. General Hospital No. 14, Fort Oglethorpe, Ga. Certain features, however, of a pathological and diagnostic nature were of such interest to us and so unlike what we had previously met with that we desire briefly to report them at this time.

Two diseases stood out above others as the producing cause of these acute middle ear infections, namely, measles and influenza. We propose to confine our remarks in this paper to the ear complications of these two diseases.

Measles.

Measles proved to be one of the most serious maladies that the army doctor was called upon to meet. Contrary to the general impression in civil life, it proved to be a disease apt to be followed by grave complications of which pneumonia and otitis media were the chief.

During the winter and spring the medical wards of the hospital were continually filled with cases of bronchitis or bronchopneumonia, mumps, and especially of measles. Of the cases of measles, a majority were complicated by acute laryngitis and rhinitis. Of these the number was large who

in the course of the disease developed an acute affection of the middle ear. Many of these in spite of the most prompt and energetic treatment, went on to acute mastoiditis, requiring immediate operation to avoid serious or fatal intracranial complications. The number of ear cases treated from January 1st to July 14th was 1,685, of which 607 were cases of measles. The symptomatology of the cases of otitis media acuta occurring in measles, was strikingly characteristic and differed entirely from the ordinary classical picture met with in civil life. The patient, more or less toxic, with elevation of temperature, pronounced leucocytosis and racked with cough from his bronchitis or bronchial pneumonia, would be found lying entirely free from all pain, either subjective or objective as far as the ear was concerned.

In fact, it was our experience that in a great majority of these cases, the ear complication was only discovered in the course of a routine examination. At the most, the patient would admit upon direct question that there was a feeling of stuffiness in the ear. The examination of the ear would show no characteristic picture. Usually the land marks were obliterated and there was a boggy unhealthy appearance of the drum membrane. If seen extremely early in the infection, there might be a slight injection in the handle of the malleus and Shrapnell's membrane. At a variable time after the onset, bulging of the drum took place in the posterior upper quadrant. To wait for this to occur almost certainly meant mastoiditis and operation. It was our rule to open the drum freely immediately upon the discovery of any change in its appearance. Often the incision was followed by a mucopurulent discharge. If the incision had been made early enough, if the infection was not too virulent and if unceasing vigil had been exercised in maintaining free drainage by repeated paracenteses, the case gradually went on to convalescence and recovery. If, on the other hand, free drainage had not been established or maintained, if the organism present, usually a streptococcus or pneumococcus, was especially virulent, if

there was a diseased condition of the nose, and finally if the resisting powers of the patient had been too much lowered, the inevitable course of the disease was toward an extension of the process from the attic to the antrum and the mastoid cells. Acute mastoiditis appearing in a patient suffering from measles was, as a rule, just as free from pain as was otitis media. It is almost impossible to believe that a patient could have a mastoid full of pus and yet insist that he is not suffering and scarcely admit any tenderness on pressure either over his antrum or over his tip. The explanation for this is not altogether easy. In some cases it was undoubtedly due to a thick outer cortex. In many, however, we are inclined to feel that it lay in the general marked toxic condition of the patient. The only sign that could be depended upon was changes in the upper posterior wall of the canal. While it was the rule to find these to a greater or less degree, according to the duration of the disease, we have met cases where they were almost if not altogether lacking. The discharge was wont to be profuse and frequently under pressure as shown by pronounced bulging in the line of incision.

In several cases an extensive destruction of the drum membrane took place which at first we were inclined to ascribe to the local anesthesia used. We were finally forced to the conclusion that it was due to the virulence of the organism present. Upon the recognition of changes in the auditory canal wall, immediate operation was indicated. In rare cases, even where these changes were absent, with excessive discharge or destruction of the drum membrane continuing for a number of days, it was our rule to operate. Any definite day of the disease for operation was out of the question. We never operated too early, even if it was only the fourth or fifth or sixth day. Often we should have operated earlier. Operation was wont to disclose extensive changes in the mastoid cells. If the operation had been performed early enough, the progress to recovery, while usually unduly slow, was uneventful.

In the after treatment, we tried in a number of cases dichloramine T. While in some cases it proved satisfactory we could not satisfy ourselves that it was materially better than gauze packing properly introduced. In one particular our experience was especially gratifying. Without exception the cases operated upon, were exceedingly sick men. In all of them the employment of the usual anesthesia, ether or chloroform, could not have failed to produce pronounced shock and thus serve as a deciding factor against the patient's recovery. In place both of ether and chloroform it was our rule to use nitrous oxide gas and oxygen. The immediate and later results were truly remarkable.

The records which were kindly prepared for me by the chief anesthetist of the hospital show that from April 3 to July 26, 31 cases of mastoiditis complicated by measles, were operated under nitrous oxide gas and oxygen. Of these ten had bronchopneumonia. The shortest time for administration was forty minutes and one was for three hours and forty-five minutes. The average time for administration was one hour and fifteen minutes. All patients were conscious before the dressing was completed. One case requiring an anesthesia of nearly four hours was particularly noteworthy. It was a man suffering from measles, double bronchopneumonia and double mastoiditis. Both mastoids were found diseased and required operation. There was absolutely no shock following the operation and the patient's temperature the next morning was virtually normal. This was true of all the cases where this form of anesthesia was employed. Beyond question it is the ideal anesthesia for such cases and commends itself strongly for all extensive or serious operations.

Two important deductions forced themselves upon us as the result of our observations of otologic complications of measles in army life.

First, that they are so unusual in their symptomatology that the only certain means of recognition is the examination of the ear itself. This in a civil hospital service is the

province of the specialist. In army life dealing with large bodies of men such special attention manifestly was often impossible. This necessitated that every ward surgeon should be capable of making a satisfactory otoscopic examination. So important did this seem to us that in connection with the work in the School of Oto-laryngology instruction was given to every member of the School of Surgery in order that he might acquaint himself with the normal and thus be able to recognize abnormal appearance of the membrana tympani.

Second, far outweighing all measures addressed to relieving infection of the ear is prophylaxis to prevent such infections from developing. Much was done in this direction both at Oglethorpe and in other cantonments throughout the country. All improved sanitary procedures, it is unnecessary to say, were to be carried out. In addition to these local treatment of the upper respiratory tract in some form or other is distinctly indicated. What is the best form of these was not definitely indicated. Gargles, such as a warm saline solution or Dobell's solution recommend themselves. For a time we used in atomizer form a 2% solution of dichloramine T which properly prepared is fairly free from irritation. The suggestion made by Lieutenant Colonel Harris P. Mosher, of the erection of steam huts for this purpose such as are now used in the British army particularly recommends itself. Any or all means such as these which will cut down the inroads of the bacillus are the only sure means to complete success in this important line of work.

Influenza.

Contrary to general expectation and to probably the common impression today, otitis media was not a frequent complication of influenza. Out of a series of some 7,000 cases, only 120 cases of acute middle ear suppuration were seen at General Hospital No. 14. There were 1,600 cases of pneumonia in this number and 66 of the cases of otitis media occurred among these. This would give a percentage

of 1.75 or about a little over 4% in the pneumonia cases. While the number was not very large, it afforded sufficient opportunity to carefully observe and note any special features. In several particulars, these were of sufficient interest to deserve brief mention.

We desire particularly to refer to

1. The drum picture.
2. The changes in the posterior superior canal wall and this significance.
3. The value of thickening of the periosteum as a diagnostic sign of mastoiditis.
4. The value of the roentgenogram as an aid in diagnosis.
5. The operative findings.
6. The time for healing.

The onset of the otitis media was apt to be insidious as in the cases of measles. Whether complicated by pneumonia or not, the cases of influenza were all suffering from elevation of temperature from 101° to 104°. In some of the cases, there was severe pain when the ear was infected; in others, little or no pain was ever complained of. Indeed, pain and temperature as a diagnostic symptom had little value. The chief reliance in diagnosis had to be placed upon the appearance of the drum membrane. This was so characteristic that it should be referred to at some length. It has been admirably described by my former assistant Lieutenant F. T. Hill in a paper on the subject as follows:

"Otoscopic examination of the case within two or three hours after the onset of the pain would show distinctive changes in the membrana tympani, always of a vesicular type. There was a marked redness and some bulging of Shrapnell's membrane in almost every case. There was frequently a large hemorrhagic bleb, bulging outward even for two or three mms. The short process often could be seen. This was the typical case seen within two or three hours after onset.

"The cases seen later showed more swelling, especially of the superior posterior portion, diffuse reddening of the membrana tympani and loss of all normal land marks. The

distinctive feature was a bleb formation. Often there were two or three of these always superior, either anteriorly or posteriorly and often dissected marginward beyond the annulus and to the wall of the external auditory meatus. These were of considerable size, often being 5 or 6 mms. in diameter, obscuring a good view of the membrana tympani. The eccentric layer of the squamous cell epithelium making explains this traveling of the blebs laterally to the canal wall.

"There was no tenderness over the mastoid process at this stage. Incision of the blebs evacuated a small amount of bloody serum. In the older cases of this could be expressed from the vesicle only with some effect, as if some clotting or organization was taking place. These blebs were true vesicles beneath the stratum cutaneum of the membrana tympani. After evacuation of these, the drum appeared red and swollen with the marked involvement of Shrapnell's membrane previously mentioned, the degree or extent depending upon the time involved. Incision of the membrana tympani in the earlier cases gave relief to increased pressure within the middle ear, followed by considerable bleeding. Later this became a profuse sero-sanguinous discharge. In the cases seen at a more advanced stage, incision evacuated this sero-sanguinous discharge immediately. The pain generally subsided about two hours after the incision of the membrana tympani. The sero-sanguinous discharge continued rather profusely for several days then gradually changed in character to a thin purulent discharge which later became of thicker consistency, apparently due to secondary infection.

Presumably we had a very acute suppurative otitis media, rapid in onset of nasopharyngeal origin. Almost from the onset, a marked epitympanic involvement became noted. An outstanding feature was the early obliteration of the superior angle of the external auditory canal and membrana tympani sometimes seen on the second day of the disease. With this there was increased swelling of the membrana tympani itself and often further bleb or vesicle formation though

after incision of the drum no new extra marginal blebs were seen. With the obliteration of the superior angle, Shrapnell's membrane became pushed downward. The line of incision frequently was depressed inwards by the increased thickness or swelling of the membrana tympani. Often a bleb or vesicle would protrude out of the incision.

Generally there was what seemed to be a hyperplasia of the mucous membrane of the middle ear. Sometimes this protruding through the opening of the membrana tympani would give the appearance of granulation of the tissue except that it did not bleed so easily. In one case this hyperplastic tissue coming from the membrana tympani higher up dissected away the superior angle of the drum, giving the appearance of a polypoid mass. This was freely movable without discomfort to the patient and did not bleed." We do not desire to give the impression that it was possible to note in all cases these progressive changes. In some cases the pathologic process was well advanced when first seen.

We would emphasize that almost without exception the subject of this ear complication was already a very sick man. The course of the disease varied. In many cases after free and often repeated incision of the drum, the discharge gradually subsided and resolution took place. In others, 21 out of 120, changes took place in the mastoid process itself demanding operation. The decision when to operate on these cases was not an easy one. As we have just mentioned, the patient was already running a high temperature. No help could be gained from the temperature chart. This also ruled out making use of the blood picture as far as the blood count was concerned.

Often careful and repeated chest examination left us in doubt as to the development of pneumonia and how to account for the continued elevation of temperature. Mastoid tenderness and especially pain was an unusual symptom. There was apt to be profuse discharge as has been described. Changes in the posterior superior canal wall were wont to be met with. While in the majority of the cases the operative findings showed that these changes were dependent (as

has been generally believed) upon the disease of the mastoid cells bordering the canal, in several such cases changes could not be demonstrated at the time of the operation. This led us to regard with less confidence such changes as positive indication in itself for operation and to believe that as a result of numerous canuliculi found in the inner portion of the posterior osseous external canal, there existed actually only an edema of the canal wall due to an extension laterally of the epitympanic process seen first as an obliteration of the upper angle. The membranous canal is less firmly attached to the osseous in this plane.

More reliable was found to be the *thickening of the periosteum* over the mastoid. In the case of unlateral mastoiditis it was often possible at an early stage in the disease to detect by careful palpation a velvety thickening on the affected as compared with the healthy side.

Finally we came to put great reliance on the value of good and often repeated *roentgenograms* as an aid in diagnosis. In this we heartily agree with Scott and others in the estimate they place upon them. I cannot follow them, however, to the extent that there exists a distinct type of cell shown by the X-ray picture which does not call for operation. The X-ray is a valuable aid to diagnosis but it has its limitations. A good picture is essential and is not easy in a bed patient to obtain with a portable apparatus. A poor picture can easily lead to error. Expert interpretation is required. A previous mastoiditis causing sclerosis seriously interferes with arriving at a correct conclusion. Simultaneous involvement of both mastoids prevents comparison which is all important.

The *operative findings* varied materially according to the time of intervention and virulence of the infection and type of mastoid. In some cases where the mastoid was opened early in the disease, little or no changes were noted. These cases went on to uncomplicated recovery, the temperature, as a rule dropping to normal soon after operation. In cases free from previous mastoid disease, it was not uncommon to find extensive cell involvement both in the zygoma, post-

sinus region and in the tip. Repeatedly pus was found in the second layer of cells adjacent to the posterior canal wall.

In our experience there was no uniformity in the nature of the organism recovered and contrary to the findings at Camp Selby and Fort Riley there was no prevailing organism recovered with sufficient frequency to warrant the term "epidemic mastoiditis".

One of the most interesting features in our series of mastoid cases totaling for the year 160 cases out of a total of approximately 3000 cases of middle ear trouble was the *slowness of healing.* Instinctively the thought presents itself that these operations had been incomplete. The fact is that extreme care was taken to search out and remove every focus of disease. The real explanation is to be found in the poor subject already reduced by disease and in the virulence of the organism. Even under such conditions attention to securing an early closure of the wound by priming partial suture and care in the introduction of the gauze packing—not too much nor too long—employed, effected very satisfactory results.

THREE UNUSUAL CASES OF MASTOIDITIS.

By EDWARD B. DENCH, M. D., New York, N. Y.

The three following cases have occurred during my practice of the last year, and have presented such unusual features that they seem to me worthy of report.

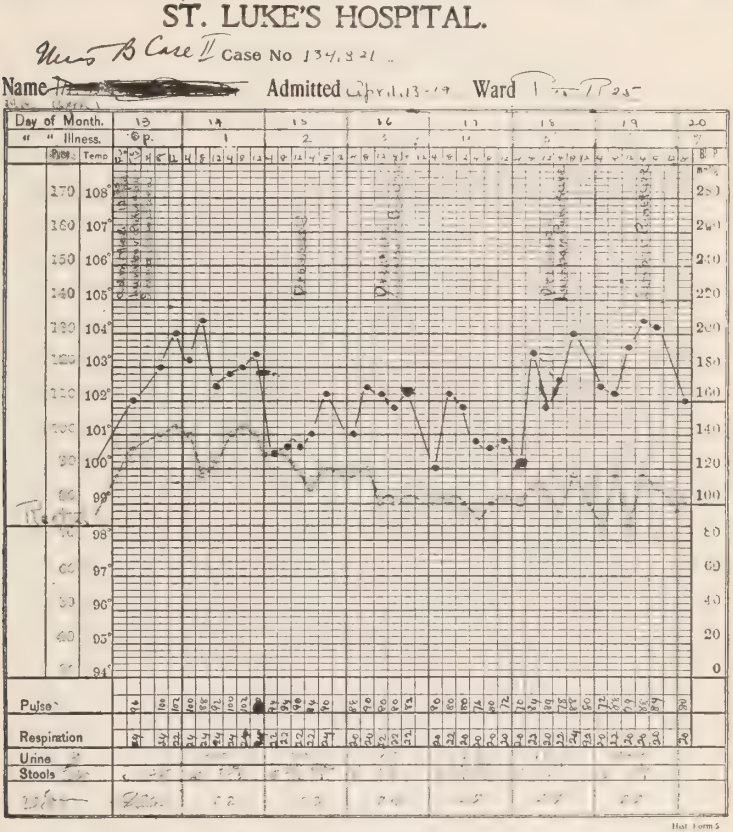
Case 1. Male, age 58. The patient gave a history of cellulitis of the neck twelve years previously which was relieved by multiple incision. Two scars could be seen, one behind the sterno-mastoid muscle and one in front of it, and one scar over the sterno-clavicular joint. The patient gave a history of a severe cold three months previous to the time I saw him which was followed by a discharge from the left ear. The discharge lasted for two weeks, and then ceased spontaneously. There was also a history of a discharge from the ear eight years before which persisted for several months. On examination the left drum membrane was much retracted, its lustre was entirely lost, it was reddened throughout, and the upper and posterior portions were bulging. There was considerable tenderness at the tip of the left mastoid. There was a boggy swelling tender on pressure below the tip of the mastoid. The X-ray of the mastoid showed both mastoids sclerotic and large. Upon the left side there were some cloudy cells at the petrous base with indistinct evidences of breaking down over the sinus. Three days after I saw the patient there was severe pain in the ear with profuse discharge, and the tenderness in the neck became greatly exaggerated. A simple mastoid operation was done. The entire mastoid was found sclerosed except for a small area in front of the sinus which was softened and filled with pus. There was no pus in the antrum. The sinus was exposed by disease. Pressure on the neck forced pus upward in front of the sinus. The entire tip of the mastoid was removed. The pus evidently followed downward in the neck through the jugular foramen. As the probe could only be introduced downward for an inch,

no counter opening was made. The wound was partially closed by sutures and Michel clamps. A microscopic examination of the discharge from the ear showed this to be streptococcus capsulatus mucosus, that is pneumococcus group three. The patient did very well for four weeks. Then pressure behind the mastoid wound forced considerable pus into the wound. Five weeks after the first operation the patient was anesthetized and the wound explored. An old abscess cavity was found at the base of the skull behind the mastoid wound, and apparently at the posterior margin of the jugular foramen. A counter opening was made and a drainage tube inserted. The previous wound was enlarged, but no diseased bone was found. About three weeks later pressure on the neck along the course of the sterno-mastoid muscle was followed by a profuse amount of pus from the mastoid wound. A probe could be passed from the lower angle of the mastoid wound downward and backward behind the sterno-mastoid muscle for at least an inch. The patient was again anesthetized, and an opening was made through one of the old scars over the posterior border of the sterno-mastoid muscle. Exploration with the finger and probe revealed no diseased bone. A drainage tube was passed upward from this counter opening to the lower angle of the original mastoid wound. Since this time the patient has been making an uninterrupted recovery, although drainage is being maintained from all three wounds. It is my opinion that this patient probably had a mastoiditis twelve years ago, and that the present attack is simply a recurrence of a mastoiditis which had been drained through the neck, the original focus of infection having never been previously discovered.

Case 2. Miss B. saw me first on March 26, 1919, with a history of influenza with discharge from the left ear for eight weeks. A physical examination showed that the left drum membrane was bulging, lustreless, and perforated. The exact location of the perforation could not be made out. The upper and posterior walls of the external auditory meatus

were collapsed. The left mastoid showed slight edema over the region of the antrum, but otherwise was negative. An examination of the discharge from the ear showed streptococcus capsulatus mucosus, that is pneumococcus group three. The X-ray showed a cloudy mastoid. Mastoid operation was performed immediately. A cortical perforation was found at the root of the zygoma. All the mastoid cells were involved, and the sinus was exposed by disease. The wound was partially closed by suture, and a gauze drain carried into the mastoid antrum, and a second drain passed over the sinus. Having in mind the nature of the infection, the wound was closed only for about three-quarters of its extent so as to permit of free drainage. For two weeks the patient did perfectly well. There was very little secretion from the mastoid wound, and the discharge from the ear became very slight, although it never ceased absolutely. The patient left the hospital at the end of one week. Two weeks and one day after the operation the patient complained of severe headache and pain in the back with vomiting. The temperature was 101.8° rectal. The next day the patient was removed to the hospital. She had a temperature of 103°, there was some vomiting and considerable headache and backache. The patellar reflexes were increased. There was no rigidity of the neck. A spinal puncture showed over 600 cells in the spinal fluid. The differential blood count showed 27,000 white cells with a polymorphonuclear count of 93%. Streptococcus capsulatus was found in the smear from the spinal fluid and confirmed by culture. The mastoid wound was reopened, and only about two drops of free pus found. An incision was then made up over the squama, and a large subtemporal area of dura exposed together with the dura over the antral roof. It might be stated here that at the primary operation the internal table over the antral roof was perfectly firm, white and glistening, and showed not the least evidence of disease. Upon exposure of the dura in this region the dura was gray and lustreless. Absolutely no diseased bone was found anywhere in the mastoid cavity. This cavity had been filled with perfectly healthy granula-

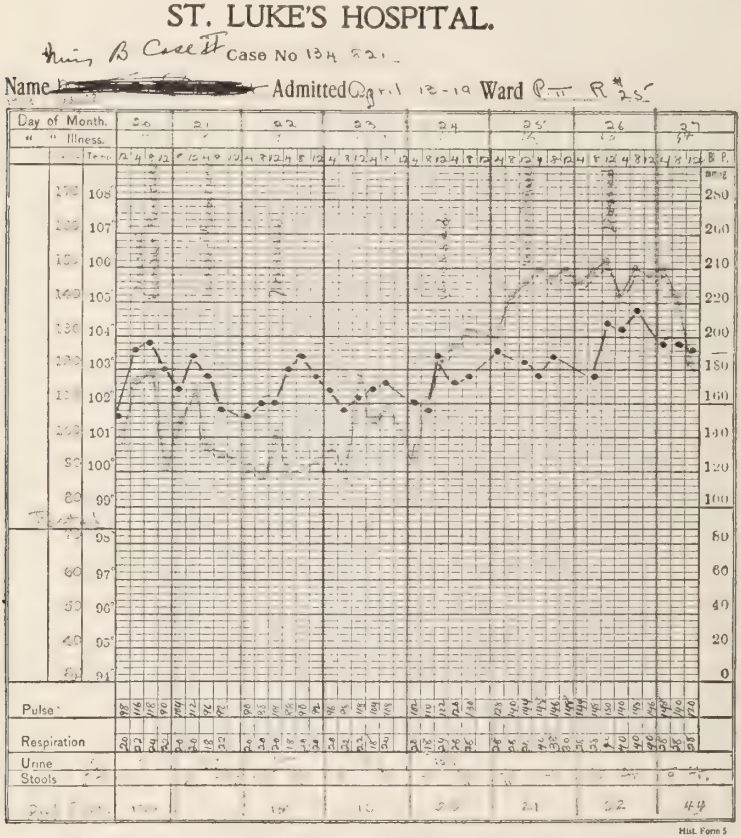
tions which were organizing rapidly. The wound was sutured over the exposed dural area, and the entire mastoid wound allowed to remain open. The temperature for the first three days after the operation gradually fell, and the patient seemed to be in fairly good condition. She com-



plained, however, of severe pain in the back and head. Repeated lumbar punctures always showed a turbid fluid with the streptococcus capsulatus always present. The patient lived for two weeks after the second operation, finally dying of her meningitis.

The attached temperature chart shows the temperature range. The case is reported for the reason that we had here

apparently a simple mastoid with a streptococcus capsulatus infection. The mastoid was thoroughly drained, and although as the result of this operative procedure the local condition was controlled, the subsequent progress of the case shows that there must have been at the time of the primary operation some infection of the meninges, although



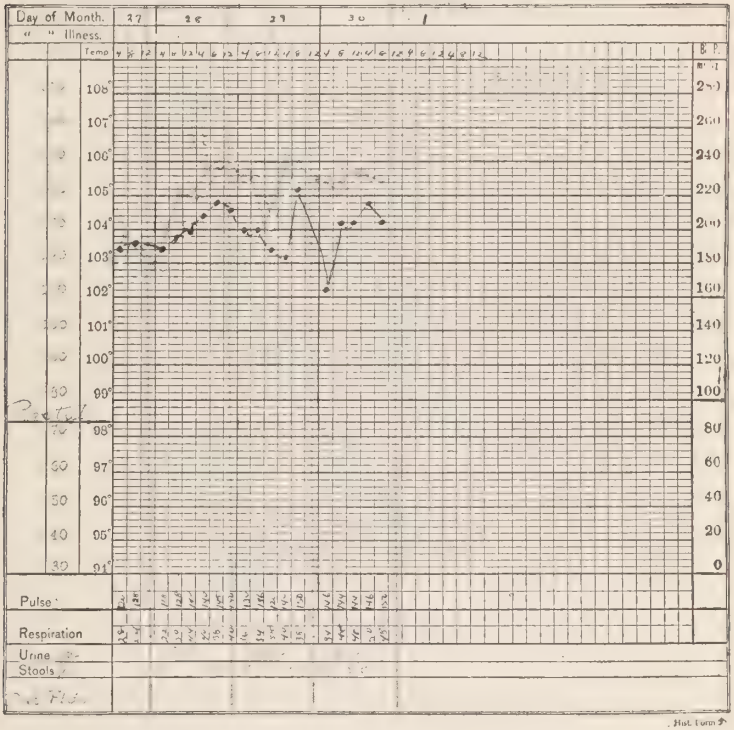
there was no clinical evidence of this at the time of the first operation. In this case a lumbar puncture was not made before the primary operation. It has been my practice for a number of years to insist upon a lumbar puncture as a preliminary procedure to all mastoid operations. Had this been done, it is probable that the meningeal infection might have

been discovered, although had we done this, I do not believe that the fatal outcome could have been avoided. It is interesting to note also that the patient lived over two weeks after the development of the meningitis, and that on several occasions a fall in temperature seemed to indicate that re-

ST. LUKE'S HOSPITAL.

Mrs. B. Case II Case No 134,821

Name [redacted] Admitted Jan. 13-19 Ward [illegible]

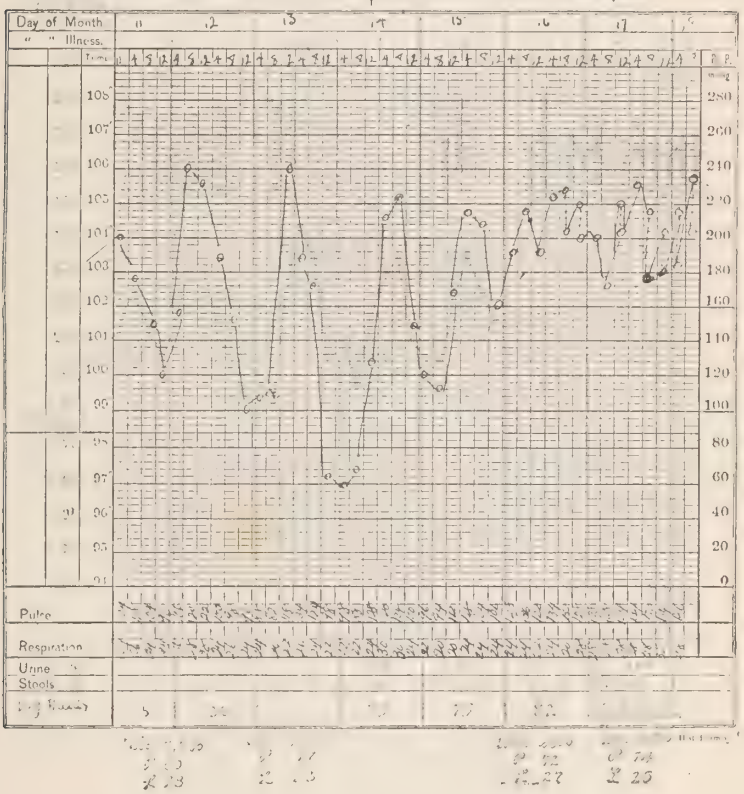


covery might be possible. The persistence of the organisms in the spinal fluid, however, throughout this time made me feel that a fatal result must be inevitable. If the patient had come under observation before so that an earlier mastoid operation could have been done, the fatal result might have been avoided. The fact that the pain in the ear had not

been very severe during the entire eight weeks, of course, led the patient to think that the aural infection was not severe, and consequently, operation was not performed until after the patient came under my observation eight weeks after the inception of the disease.

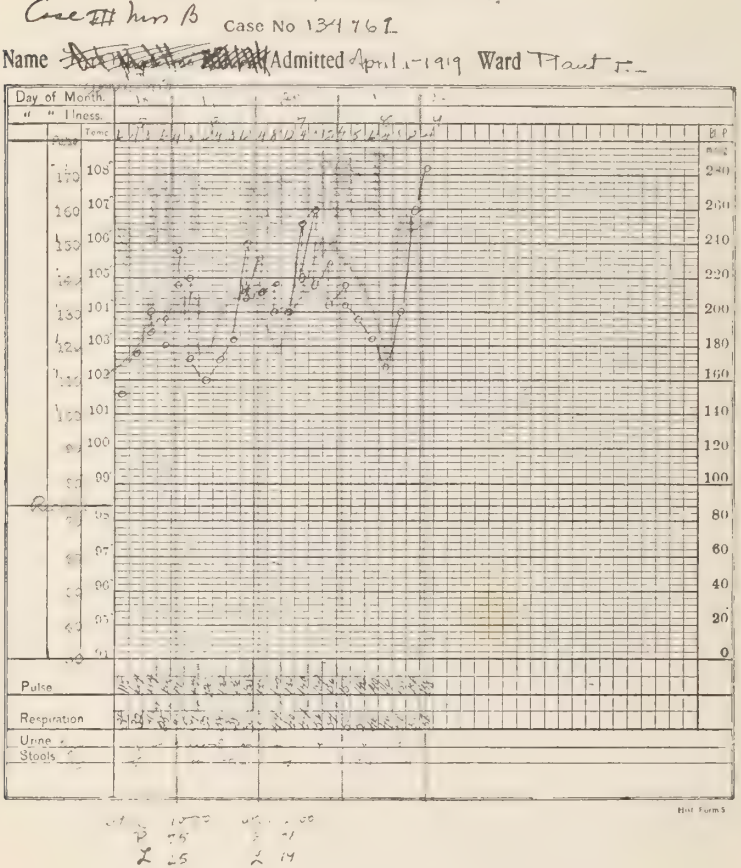
Case 3. Mrs. B. gave a history of an attack of influenza three weeks before I saw her. Nine days previous to coming under my observation the right drum membrane was incised, and the physician in charge assures me that at this time the right drum membrane showed no appearance of a previous suppurative process. On examination of the ear, when I first saw the patient, the right drum membrane presented a perforation of considerable size in the posterior portion. The appearance of the perforation was one of long standing, although I was assured by the attending physician that the drum membrane had presented no evidence of a previous suppuration nine days before. The left drum membrane was normal. When the patient came to the hospital the temperature was 104°. It fell spontaneously to 100 , but rose the next day to 106°. I might say that these variations in temperature had been present for five days before I saw the patient. A blood culture was immediately taken, and this was negative at the end of twenty-four hours and remained so. The radiographs of the mastoid were practically negative. The spinal fluid was negative. The right labyrinth was active. The blood count showed 5,700 white cells, with a polymorphonuclear count of 80%. Two days after admission to the hospital the temperature rose to 106°. An enteric condition was discussed, but the Widal reaction while suggestive was not considered positive by the laboratory. Forty-eight hours after the patient came under my observation I opened the mastoid, found some pus in the tip cells, and exposed the sinus and the dura in the middle fossa. The dura in the middle fossa was normal. The sinus was cloudy at its bulbar extremity. The internal jugular was then excised from below the omohyoid to the base of the skull. The sinus was opened, a parietal clot removed from the bulbar end,

and free hemorrhage obtained. Free hemorrhage was also obtained from the torcular end of the sinus. The wound in the neck was closed with clamps, a rubber tissue drain having been inserted for the length of the wound. Packing



was also placed at the upper end of the wound over the upper ligated extremity of the jugular. The temperature fell immediately after operation, but rose higher and higher each subsequent day until death occurred eleven days after the operation.

All subsequent Widal reactions were negative, although the patient presented many enteric symptoms. The tests for paratyphoid were also negative. The spinal fluid remained negative throughout. A questionable positive blood culture



was obtained late in the disease. The aural infection in this case was streptococcus. The chart gives clearly the temperature range in this case. I believe that this patient died not of streptococcemia, but of typhoid, although this could not be demonstrated by the laboratory. On the other

hand the blood did not show clearly a streptococcus infection, although this was the aural infection. This patient was apparently suffering from two distinct conditions, one an otitis media which had led to the formation of a parietal clot in the lateral sinus, and the other some enteric condition closely simulating typhoid, although the Widal reactions did not prove this. The presence of an enlarged spleen and the appearance of rose spots seemed to point clearly to the presence of typhoid. In my opinion the patient was suffering from two conditions, one a sinus thrombosis which was relieved by operation, and the other a constitutional infection probably typhoid of which she ultimately died. The chief interest in the case centers about the temperature chart. The early history seems to clearly indicate a sinus thrombosis, but the gradual continued high temperature would point to the enteric condition already alluded to.

Discussion.

Dr. Edward B. Dench, New York City, discussing Dr. Goldstein's paper, had had very little experience in doing mastoid operations under local anesthesia. He recalled, however, a case in which he removed a very extensive clot, extending from the jugular bulb to the omohyoid muscle, under local anesthesia. He asked Dr. Goldstein whether he had had any sloughing from the use of adrenalin. The speaker had had a good deal of sloughing, probably because he had used the adrenalin too strong.

Referring to Dr. Harris' paper, he said he had seen very few cases complicating measles at Camp Upton, probably because this was a new camp. As to the cases which occur without sufficient signs on speculum examination to warrant operation, he wondered if some would not recover spontaneously. Men who who were not accustomed to examining ears were apt to misinterpret slight changes in the appearance of the drum membrane.

The speaker had been very much interested in Dr. Harris' remarks about oxygen and ether. In the presence of pul-

monary complications this was the ideal anesthetic. He was also interested in hearing what Dr. Harris said about mastoiditis in influenza. Out of 870 cases of influenza at St. Luke's Hospital from the 26th of September to the first of March there were only twenty-five cases of mastoiditis. In order to see what influence influenza had in the production of mastoiditis, he looked up the records of the hospital from the middle of September to the middle of March of the preceding year, and found that there had been ten cases more than during this year.

Dr. Harris' statements concerning X-ray examinations were confirmatory of the speaker's experience. While the X-ray was undoubtedly a valuable aid to diagnosis, it might be misleading. He recalled the case of a man who, four years ago, had an acute suppuration. The X-ray, at that time, revealed a black area over the left lateral sinus. The same black spot was shown on the X-ray plate made two weeks ago. The man had a very superficial lateral sinus.

Dr. Francis P. Emerson, Boston, Mass., said much that Dr. Harris had given as his experience had been repeated in other cantonments. At Camp Lee, where there were four thousand cases of influenza, only one mastoid came to operation. Subsequently there were a good many mastoid operations. As Dr. Harris had well said, the most troublesome cases were those following measles. Possibly the lack of symptoms was due to the toxic condition of the patients. The hemolytic streptococcus was found in the throats of cases following influenza running as high as 25-70 per cent. of all organisms. In the measles cases there were very few subsequent symptoms. With regard to the examination of cases of mastoiditis, the most constant symptom was sagging of the postero-superior wall. There was very little tenderness over the tip of the antrum. In many cases operation was done on account of the extreme deafness, and in others because of a profuse discharge which could not be accounted for from the condition of the middle ear. He did

not agree on the question of early operation, as the discharge continued for a long time unless the process had become walled off. If one did free paracentesis it was very seldom that serious complications followed. His experience had been that post-operative cases did not do as well as those in civil life. It was very difficult to get ward surgeons to use judgment in the packing of their cases. Following complete exenteration of the mastoid cells it was important to keep the aditus open until the middle ear is dry. After this stop all packing and simply separate the wound and let the serum escape. Repeated packing of the mastoid would lead to the formation of a sinus extending into the middle ear. The exercise of good surgical judgment in these cases was very important.

Dr. Emil Amberg, Detroit, Mich., had used limited local, and general anesthesia latterly, following Crile's idea. In adults he used morphia, the local anesthetic on the line of incision and then ether. He would prefer as a routine measure in adults nitrous oxide oxygen, with a little ether which he has also used. As Crile had pointed out, the shock to the central nervous system was less with nitrous oxide than with ether. Crile has shown that the changes in the brain cells were about three times as great under ether anesthesia compared with nitrous oxide anesthesia, and the fall in blood-pressure was on the average two and a half times less under nitrous oxide than under ether. He was sure that his patients felt better after operations with this avoidance of shock than when the other method was employed. He had not employed nitrous oxide in children for mastoid operations. Of course the mental attitude of the patient came into consideration. Crile had shown that fright causes the same change in the cortex of animals as prolonged physical trauma.

He had adopted a very simple rule regarding the X-ray in mastoiditis: If the X-ray demonstrates definitely something that cannot be discovered by clinical means, the X-ray

is followed; but if the clinical symptoms demonstrate facts not shown by the X-ray, the clinical symptoms are followed.

If the patients were kept in bed and quiet it might be that this had something to do with the prevention of subsequent mastoid complications. Complications were very apt to follow the ambulatory treatment of otitis media.

Dr. R. Bishop Canfield, Ann Arbor, had found that a solution of adrenalin, five drops to the ounce, gave exactly the same effect as the stronger solution advocated by Dr. Goldstein without the toxic effect. The protracted after-treatment necesary in so many post-measles mastoiditis cases was due to infection from the scalp. The scalp is filled with staphylococcus albus which makes its way into the mastoid cavity which is in no condition to resist this reinfection. This new infection accounts for many cases of protracted discharge after a satisfactory operation has been performed. This protracted after-treatment can be avoided by being careful not to permit any of the dressing material, the instruments or the hands to come in contact with the scalp and by the frequent use of idodine around the wound. By making frequent cultures of the deeper parts of the wound cavity after the method used in the Carrel-Dakin treatment, the earliest date at which the cavity can be closed can be learned.

Dr. Edward Blair Sutphen of Morristown, New Jersey, said there were very few cases of mastoiditis at Camp Taylor during the early part of the influenza epidemic. Only two cases, in October. From the first of November, there were, on an average, twenty cases a week. Streptococcus hemolyticus was found in all of the mastoids. They were hemorrhagic and very acute. Some were operated upon in less than thirty-six hours after onset of ear symptoms. In those cases of a few days' duration, there was great destruction of the mastoid. The cases healed as quickly as those seen in civil practice. Dichloramine—T was used in dressing some with marked success.

Dr. Wendell C. Phillips, New York City, had been interested in the statements made regarding the relative frequency of mastoid complications in influenza. He had a fairly large service at the Manhattan Eye and Ear Hospital, and the hospital had a fairly large service. During the time of the fatal influenza cases, in October, November and December, the mastoid service of the hospital was at the lowest ebb that it had reached for several years. This had led him to believe that this particular epidemic of influenza did not lead to this complication. It was only when they began to get the type of influenza that was seen year after year that they began to have this complication.

He warned against the use of the hypodermic injection of adrenalin in cases of arteriosclerosis.

Dr. Frank T. Hopkins, New York City, advocated the use of saline spray in the prevention of aural complications of measles and scarlet fever. Several years ago he had had many cases of these affections with no aural complications, and in every case he had used this precautionary measure.

Dr. Don M. Campbell, Detroit, Mich., had had a small experience compared with that of the military practice, yet in Detroit there was a considerable epidemic of influenza. Among the nurses at Harper Hospital there were sixty-eight cases, in seven of which there were complications referable to the ear. Some of these seven cases presented interesting features bearing upon the present discussion. First of all, they presented the characteristic appearance of the drum membrane, the dark, necrotic appearance in the advanced cases. The appearance of the drum membrane was not so characteristic in cases not so advanced. All of the sixty-eight cases were put to bed. Of the seven cases of ear infection, only one went on to suppuration or demanded paracentesis. Of the cases that did not exhibit the physical appearance upon otoscopic examination which would ordinarily demand paracentesis, every one went on to perfect recovery. This infection, influenza, had not the tendency of producing mas-

sive infection, as in the tonsil, the mastoid, and the cervical glands. That was a very important observation in connection with what Dr. Goldstein had said about the questionable wisdom of incising the drum membrane before the physical condition really demanded it, as shown by the bulging and the disappearance of the landmarks.

The importance of the X-ray as an aid to diagnosis in these cases rested upon the comparative study of plates made at different intervals.

Dr. James M. McTiernan, New York City, said of the six thousand cases of influenza at Camp Meade there were only forty-eight cases of acute otitis media and not one case of operative mastoiditis, up to the expiration of his service there. When he returned to the camp he learned that there had been one operation. He asked if Dr. Dench operated upon the twenty-five cases mentioned. The higher percentage of mastoid cases seen by Dr. Dench than observed in the army was probably to be accounted for by the fact that early paracentesis was not done in civil practice. In his discussion of the complications of influenza at the meeting of the American Medical Association he had called attention to the small bleb and the minimum amount of redness on the drum membrane as the commencement of otitis media.

Dr. John B. Rae, New York City, said that detailed reports from the Expeditionary Forces would recommend the almost exclusive use of local anesthesia in all head operations. Toward the end of activities there was one Mobile Hospital to which only head cases were sent and in which practically all operative work was done under local anesthesia.

Practical experience teaches us that ear complications in measles and scarlet fever vary in different years with the nature of the epidemic, and that it is hard to make broad general statements which will always apply. Thus the

measles of one year may have many complications, while in the next, ears will be conspicuous by their absence. He had advocated the early opening of the antrum in little children, not only to secure drainage but especially to save the bony structures of the middle ear which become involved at an early period in these cases.

Dr. George L. Tobey, Boston, Mass., called attention to the coincidence that patients giving a history of a previous attack of influenza appeared to have lost their immunity, the mastoid in such cases breaking down. Other complications had been noted; for example, he had never seen so many intracranial complications as he had during the last few months, and in practically every case there was a history of an attack of influenza last fall. They apparently developed aural infection and went on to breaking down. These patients seemed to have no resistance at all. He wondered if it was merely a coincidence, or if others had had a similar experience.

Dr. Christian R. Holmes, Cincinnati, Ohio, emphasized Dr. Rae's remarks concerning the variation in the intensity of the virulence. Because of this one could not really judge as to whether patients were attended to better in one camp than in another. At Camp Sherman, where the epidemic of influenza was very severe, with a loss of eleven hundred men, there had been many mastoid cases. They were not all from influenza, however; some were from diphtheria, scarlet fever, and measles. Two men were assigned to go from ward to ward daily and to inspect the men,—not to wait until they were sent to the head house to examine the ears. Paracentesis was made immediately in all cases showing acute inflammation. He had taught his assistants that safety lay in early operation. He recalled one case that was operated upon within twenty-four hours after the beginning of the earache. Statistics always varied, but it was important,—and this should be emphasized for the benefit of the

young men—that when an abscess appeared in any part of the body it should be opened without waiting for it to assume large proportions. Early paracentesis and early mastoid operation would give better results.

Dr. Ewing W. Day, Pittsburg, Pa., recalled the fact that when he read a paper before this Society several years ago, on the subject of mastoid operations under local anesthesia, there were a good many "Doubting Thomases." At that time he had used it in about fifty cases. He believed it to be a great improvement over general anesthesia and over nitrous oxid. It was possible to get complete anesthesia over the part without alarming the patient. There were two kinds of pain, mental and physical. In the average operating room there was a "Don't disturb the corpse" attitude, which was enough to scare the patient in the first place. Lately he had gone back to giving a quarter of a grain of morphin and a hundredth of scopolamin one hour before operation. He then took plenty of time with the injection. If the patient had had the morphin, and the injections had been made carefully, and if the deep injections to which Dr. Eagleton referred had been attended to, the chisel could be used without discomfort to the patient. One should keep up a continuous conversation throughout the operation. If one would do that there would be no difficulty. He recalled one case in which he did a double mastoidectomy, and the man walked back to the ward and was sitting up in bed eating when he went in to see him. If one could get rid of the mental pain there would be no physical pain. He had had no sloughing. He did not like the animal products. He used epinin, made by Burroughs, Welcome and Company, which was a synthetic product. Morphin given beforehand was superfluous except that it helped the mental attitude of the patient. It might be added that the morphin controlled the after-pain. The patient would sleep well sometimes through the night, or even on to the next morning. There might be a little pain from cutting the sterno-mastoid muscle, and there might be a little stiffness of the neck.

Dr. Harris, in closing the discussion, said the war had brought phases of mastoid work deserving of just such a discussion as had been given to it to-day. First, the question of early incision: In his attempt to develop the subject he did so chiefly along the lines of measles and influenza. In measles the earliest incision possible was called for. In the measles wards at Camp Greenleaf there were hundreds of cases at times. Some of the very best men were assigned to the wards for these ear examinations. They did not wait for complaint of symptoms, but as soon as there was any change at all in the drum membrane they incised. It was quite interesting and almost "spooky" to note the improvement after the incision of the drum membrane. It was quite different in the influenza wards. In these cases early incision of the bleb on the drum membrane was indicated. These cases did not go on to mastoiditis of the operative type. There were very few operative cases of mastoiditis following influenza at Camp Greenleaf, and the experience there certainly indicated early operation.

He considered gas-oxygen the ideal anesthetic. He had seen patients with double pneumonia, with vestiges of the measles, with temperature of 103° or 104°, come out of the anesthetic looking happy and bright, with no shock whatever. He was sure that these patients would have been hurried into eternity by the use of either chloroform or ether.

The measles patient was invariably put to bed. A bacteriological count was made in every case. Trying to prevent infection from the scalp or otherwise undoubtedly shortened the period of post-operative dressing. Repeated X-ray examination was almost essential in these cases, where operation was doubtful.

The use of vaccines was very thoroughly carried out at Fort Oglethorpe, and the medical men thought it had considerable effect in cutting down the incidence of pneumonia.

Dr. Dench, in closing the discussion, said, in reply to Dr. McTiernan's question, that the cases to which he referred

did not develop in the hospital but outside. Every case seen in the hospital was incised. The bleb formation mentioned, which was external otitis hemorrhagica, had not been as prevalent in this epidemic as in the one of 1895. It was the rule in the earlier epidemic but not in this one. Leucopenia and low poly count had been noted in the cases under his observation.

Dr. Goldstein, in closing the discussion, said the one significant feature of mastoiditis in the influenza epidemic was that in most of the cases the drum membrane presented a peculiar bleb which, on puncture, exuded serum and not pus. The relationship of the few mastoid complications to the large number of cases was also significant. Significance was to be attached, likewise, to the fact that the streptococcus hemolyticus is not a pus-producing organism. If the bleb was punctured the case healed; if complete paracentesis was made mastoid complications followed, showing that the hemolytic streptococcus was the initial infection and that the tissues responded enough to ward off other complications. By hemolysis the hemolytic streptococcus changed the mucosa so as to make possible the entrance of other complications into the upper respiratory tract.

Emphasis was placed on the fact that the injection is a pressure problem, and that it made little difference what was used so long as it controlled the nerve-end elements over the site of the operation. Doubtless after local anesthesia had been more generally adopted the procedure would be more definitely standardized. If a solution of 1-10,000 adrenalin caused unpleasant after-effects the strength should be reduced, or it could be eliminated entirely. Sterile water would answer the purpose.

Chiseling did not produce pain; it might cause an uncomfortable concussion, of which some patients complained. He had seen doughboys smoke cigarettes and keep up a running fire of witticism while the operation was in progress. The psychological element was important in the use of local

anesthesia. Local anesthesia had come to be used in the camp as a matter of necessity. Ether pneumonia was dreaded in these influenza cases. He had employed it in several cases outside of camp. He would not select a highly neurotic patient for the method. Answering the question whether he would be willing to undergo a mastoid operation under local anesthesia, he said he would if he could select his operator, especially after the method had passed through the experimental stage. General anesthesia after middle life was not so easy as in younger subjects. Local anesthesia had its possibilities. After it had undergone evolution and modification it might become the method of choice. He was endeavoring to develop a syringe by means of which the injection could be made under compressed air. By using compressed air, with an automatic cut-off, the injections could be made more uniformly and steadily than by the hand apparatus.

HAY-FEVER AND ASTHMATIC OBSERVATIONS FROM A NASAL MEMBRANE VIEWPOINT.

By SARGENT F. SNOW, M. D., Syracuse, N. Y.

My hay-fever and asthmatic observations cover a period of over thirty years and the deductions I have formed from experience I will try to submit to you fairly and impartially.

The fact that it is estimated, by no less an authority than Dr. William Scheppegrell of New Orleans, President of the American Hay-fever Prevention Association, that 1% of the population of the United States is subject to hay-fever,—and that of this 1% hay-fever people, 40% are also asthmatic,—justifies any of us in an attempt to contribute something toward the relief of this distressing and harassing condition.

The relation between hay-fever and asthma appears to be so close and intimate that I find myself placing them in the same class and as amenable to practically the same treatment.

Since retiring from the practice of general medicine, twenty-eight years ago, I have had the usual quota of such cases running well into the hundreds, as will naturally come to a man confining himself to the ear, nose and throat specialty, and am pleased to report that my confidence in our ability to give these people marked relief, has increased from year to year.

I realize that the line of treatment I have followed is not in accordance with the popular inoculative trend of the day and I wish to state *with emphasis,* that I am in thorough sympathy with the efforts to place the treatment of hay-fever and asthma on a more scientific basis, as has been evidenced by recent developments elucidating anaphylactic and protein problems, the literature of which is both voluminous and instructive.

It is proper too that the first problem should be to find the cause of the disease, and much has been accomplished in

this direction, but with all due respect to the achievements of earnest investigators in the past five years toward clearing up etiological points, and giving us hope of a successful pollen and vaccine therepy, I would respectfully suggest, to those who are not situated so they can carry out a treatment along anaphylactic lines, a working plan which my experience has shown to be of decided benefit and effective in at least 80% of our cases. In a goodly number this plan or method can be used, pending the time when we have a more sure and safe "short cut" to the desired goal.

It is generally agreed that the cells of the body possess proteolytic powers which act in a measure as a natural defense against the invasion of foreign proteins. The atmospheric pollens of hay-fever are inhaled by all in our daily vocations, but it is evident that 99% (see Scheppegrell, "The Laryngoscope" Dec. 1918) are immune to these inhaled pollens because our protective enzymes digest or destroy the protein substances so that we suffer no marked disturbance from resulting toxins. In the hay-fever subject, however, these protein substances are not neutralized by normal protective agencies and they suffer from pollen sensitiveness. It is to these "Normal Membrane Protective Agencies" that I would most earnestly call your attention.

Following the idea that nature gives us immunity from pollens if our nasal membranes are functuating properly, I have consistently and persistently bent my energies toward obtaining and maintaining a normal condition of the nasal and accessory sinus membranes in each and every hay-fever and asthmatic patient under my care.

I claim no priority nor make no apology for having adopted this plan of treatment, for you will remember that in the early nineties, when I began observation on these cases, we knew nothing of anaphylaxis and but very little of remedial agencies; except inhalants and antispasmodics. The recognition of the baleful effects of spurs and enlarged middle turbinates was being noticed, (see Wm. H. Thompson Reference Handbook, page 295) and I still remember astonishing benefits that followed some of these cor-

rections;—then came the time when we scrutinized more closely the accessory sinuses,—each effort in this direction seeming to have beneficial effect on a good percentage of cases until at one time I remember I was almost ready to declare that all cases of hay-fever and asthma were amenable to intranasal treatment.

The next development in my personal observations was on the proteolytic provisions of nature, and as I was soon impressed by the fact that a normal nasal mucosa was capable of withstanding the irritating effects of inspired pollens:—This of course easily led to the conclusion that a logical treatment of hay-fever and asthma, was as above indicated, to correct intranasal states that were inhibiting normal proteolytic membrane secretions.

That my deductions were safe and dependable is proven by the clinical results that have accumulated in the past twenty-eight years: In my practice I can recall but few cases where there was no evidence—past or present—of an intranasal or accessory sinus factor;—This intranasal or sinus factor may not be prominently marked upon the first examination, but in cases that have been under more or less prolonged observation, I have practically always found their membranes or passages abnormal.

The logic at least, of my position is supported by some of the recent contributions to our literature. Notably:

Sewall & Powell, Arch. Int. Med., Vol. XVI, Page 645, in 1915, says:

"The mucous membrane of the nose seems to be the organ par-excellence through which the relation between the *antigen* and the living tissue are mediated. Every *breath* of air contains organic matter which is liable to settle on the mucous membrane and there set up a profound reaction."

Eves, Penna. Med. Journal, Vol. XXI, page 617, in 1918, says:

"The local condition of the nose should be looked after *before* the period of the attack. A badly deflected septum increases the pressure and obstructive symptoms favor the lodgment and retention of pollens in the nose. Likewise should hypertrophic rhinitis, polyps, and cystic turbinates be corrected long before the hay-fever season."

H. L. Pollock of Chicago, in the July, 1918 number of "The Laryngoscope" page 544, calling attention to a dis-

harmony of the ductless glands as a possible etiological factor, also says,—

"We know that many cases of asthma are associated with some pathological conditions of the upper respiratory tract such as suppurative ethmoiditis, with or without polypi formation; hyperplastic ethmoiditis or a suppuration of the antrum or sphenoid. Yet, that this pathological condition is not the underlying factor, is proved by the large number of patients who give evidence of these conditions without showing the slightest symptoms of asthma. These conditions certainly play an important role as an exciting cause, because after having these pathological conditions cleared up, all cases are benefited to a greater or less degree. I have yet failed to see one whose asthma became aggravated by surgical intervention on the sinuses.

"In many of these cases treated by the general practitioner, the condition of hyperplastic ethmoiditis especially is overlooked, as it is not easily diagnosed, and consequently many patients are reported as being free from any pathology of the upper respiratory tracts."

From personal experience, I quite agree with these observations and would report five cases typifying the extreme and difficult situations which we are sometimes called upon to meet. They have been chosen for description, because each have been examined or heard from directly within the past month so that I know positively their present condition.

These sample cases have been under my observation, or of easy access, since the beginning of their treatment, which in three of the cases has been seventeen years and two of them, fifteen years. Three have presented recurring tendencies, too, which had to be met adequately or I would not now be able to make the report that I still enjoy their confidence. Not that each case has been discharged as a cure, for most of these hay-fever and asthmatic people have membranes that have been so long diseased and are so hypersensitive, or have underlying systemic factors so active, that it is unsafe to let them expect complete relief just from a septal resection, middle turbinate trimming, or sinus exenteration.

To avoid tiresome detail and save time I will touch only on the prominent features of their symptoms and condition, as shown by my notes and from my recollections.

Case No. 1.—Mr. Wm. A. M——, aged 25, farmer, examined July, 1902, in fair general health, giving history of active catarrhal states, with occasional hay-fever symptoms for five years, sensitive to horse and hay dust,—an extreme sufferer upon exposure to these irritants; and much discouraged because the death of his father placed heavy agricultural duties upon his shoulders. A marked septal deflection and shelf, blocking the left nostril was found and corrected, first trimming an enlarged right middle turbinate so as to allow the replacement of the septum to the median line. This work was followed by a rapid lessening of the nasal turgescence with such relief of the hay-fever and asthmatic symptoms that within two years Mr. M——— was able to curry his horses and work with the threshers in the most dusty positions. This recovery has proved permanent, though he says to-day, 17 years later, that he finds it best to have a treatment and look-over two or three times a year.

In these observation treatments I simply use an alkaline cleansing solution, and a fine spray of Iodol, Menthol and Ether, one grain each to the ounce, touching up any granulations in the pharynx that may have developed with Nitrate Silver 40 grains to the ounce.

Case No. 2.—Thomas G———, aged 14, son of a farmer, examined July 15, 1902:— Patient was small for his age, with thin, pinched features; complained of hay-fever and asthmatic attacks, growing worse the past year. Severe and frequent headaches that also seemed to be increasing. The septum was found deflected to the left with a large degenerated middle turbinate filling the abnormal space in the right nostril. Small polyps could be seen in the ethmoid region, but no pus.

The degenerated middle turbinate was removed by a cold snare and the polyps and softened bone curetted from the ethmoid, with the result that the hay-fever, asthma and headaches disappeared, the general health improved and the boy became a sturdy farmer. This case has proved interesting because in the fall of 1914, twelve years after my

first observation he again came to me saying that the old hay-fever and asthmatic attacks had come back.

Examination at this time showed a suspicious middle turbinate on the left side upon removal of which, the ethmoids were found to contain small polyps with the usual bone softening. A thorough curettment of these tissues and resection of the deflected septum was done in two sittings and the patient has been able to resume his farm work, with success, though I had to cauterize some sensitive areas, threatening hay-fever, that appeared in his nose last summer. Two weeks ago he reported that he has had no head troubles the past four winters, cares for his own horses, pitches his own hay and thinks he is well.

Case No. 3—Miss H———, aged 23, examined July 20, 1909, giving the same general history of hay-fever, asthma and headaches for five years. Practically the same line of operative work was resorted to as in case No. 2, with equally as good results, the patient gaining ten pounds in weight during the first year, though she too reported last fall with some hay-fever symptoms and sensitive nasal areas that subsided after an application of an 8% chromic acid solution, to the sensitive points.

The idea of the chromic acid application to the exit of the ethmoid nerve areas was first suggested to me about 1897 by Dr. Scott Renner (of Buffalo), and I have found it very useful. It gives us something we can do in the activity of the paroxysm, and we can rely upon it being effective if we succeed in de-sentizing each sneezing area by the caustic action. The benefit lasts until the next season, and I have had cases that seemed to retain the benefit for two seasons.

Personally I use the 10% solution now, and carry some of the applications to the region of the Meckel's Ganglion, behind the posterior tip of the middle turbinate, when the preliminary cocainization opens the passage so that the caustic can be applied with reasonable precision.

Cases No. 4 and No. 5, that I will describe are older people and represent the chronic asthmatic class. The first

mentioned was a Mrs. McD———, a lady of about 45, whom I first saw under rather dramatic circumstances in 1908. One night I was awakened by a frantic pounding on our door and urged to come across the hall to a neighboring apartment to "see a woman who was dying", and I will say now that she was the nearest to death that I ever saw an asthmatic; her appearance was certaintly startling, the face and neck being of the darkest ash-gray color, almost no pulse, and only a shallow, panting kind of respiration. As I had no hypodermic or medicines, I looked about for household remedies and found traces of an antispasmodic that she had been burning. Inquiry showed that they had more of the same, so after directing that some fresh should be prepared, I improvised a tent, or hood, out of newspapers, held the fumes close under her nose and was soon rewarded by a better pulse, deeper respiration and returning color. Within a few days the lady came to my office and an examination showed a slightly degenerated middle turbinate on the right side, light colored in the posterior half,—a guarded prognosis was given as she claimed she never had a stuffed nose or much catarrhal trouble, still, she had been such a sufferer for five years from asthma, it was decided that I should see what could be done.

Accordingly on June 26, 1908, I removed the middle turbinate and found by curetting that the posterior ethmoid walls were easily broken down, though no real polypoid structures were found.

The good effects of this improved sinus drainage was almost immediate, and the patient now, eleven years after the operation, says that she considers herself cured.

Case No. 5.—Mr. A. H———, aged 65, was referred to me March 29, 1909, by Mr. William A. M———, the first case described. Mr. A. H. lived on a farm but had not been able to work for more than a year. His condition was typical of the severe chronic asthmatic state, the attacks being almost continuous, and he was hardly able to talk while answering my questions. Examination showed a man feeble, and prematurely aged. He gave a history of having had

repeated polyp removals and asthmatic attacks for fifteen years. I found that the middle turbinate had been amputated at some previous operation but small polyps could be seen in the posterior ethmoid and phenoidal regions.

I remember this case very clearly because of the amount of bone degeneration and polyp accumulation in the sphenoid cavities. Twice I feared that I had done more operative work than his enfeebled state would justify, but he rallied in a surprising way and persisted in returning for more until I had all diseased bone and degenerated tissues cleared out. Four sittings under cocaine anesthesia, between March 30 and July 2, 1909, and another May 25, 1910, for a small polyp in the right sphenoid region, completed our operative efforts, and my notes as shown by an examination Oct. 19, 1916, proved again that it was possible to stop recurring polyps, in even so chronic a case, as none of them were found seven years after their thorough removal and a curettment of the softened bone from which they sprang.

I should mention here, though, that it is my custom to apply the weak chromic acid treatment, before described, at intervals of two or three weeks to the diseased bone areas, until the newly formed membranes stay quite pink and healthy.

On his last visit to me in 1916, Mr. H——— stated that he was almost well; if he had any asthma at all, the paroxysms were mild, and on April 25th of this year, Mr. M———, the neighbor who referred the case to me, says that Mr. H——— has had no asthma of late years, and seems to be enjoying life.

I don't consider these cases cured, as I said before, but each of them has nasal or sinus factors which when corrected and kept under control, resulted in the patient staying in a very comfortable and satisfactory condition.

I could keep on citing cases by the dozen that have shown equally as good results, several under observation twenty and twenty-five years, who still report to me two or three times a year for a "Look over." Proper treatment does not

always depend upon pure nasal work for there seems to be digestive neurotic or intestinal factors in a certain percentage of cases that tend to keep membranes in a hypersensitive state:—extreme fatigue, constipation, and careless exposure should of course always be guarded against.

Occasionally we find in a chronic asthmatic case, a purulent sinusitis, and in these it has been my practice to at least try the administration of potassium iodide in conjunction with our efforts, regardless of negative histories.

It has been my experience that the enlarged sinus openings we make sometimes close up, by a re-development of the naso-sinus wall, especially of the sphenoidal;—polyps may recur and block our drainage, catarrhal states become active and hyperplastic ethmoiditis again become manifest, hence these people should be kept under observation for quite a time after the operative period; in fact I never feel sure the relief from spasmodic seizures is permanent, in the chronic asthmatic.

Rackemann of the Massachusetts General Hospital, in analyzing 150 cases of bronchial asthma, (Boston Med. & Surg. Journal, 1918, CLXXVIII-770) gives this excellent classification.

Extrinsic causes—Pollen, horsehair, and food.

Intrinsic causes—Gastrointestinal, bronchitis, tuberculosis.

Nose, Teeth—Personally I should place the nose as the first intrinsic cause. It is admitted that in 99% of our population, the proteolytic enzymes neutralize pollen products, then why is it not reasonable to go after that other 1% from an intranasal viewpoint.

We must all concede that laboratory men, generally, have done wonderful work on etiology and anaphylaxis in the past ten years, but I believe the time has come when the nose and throat man should take his share of the responsibility for the development of remedial measures. Both efforts are commendable.

I don't think the rhinologist should depend too much upon the results from septal or turbinate corrections. He must go deeper and solve the problems of the accessory sinuses;—

he must follow up his case, watching out for pale, degenerated membranes and apply adequate stimulating treatment to maintain a bettered membrane state.

The endeavor to correct a nasal or accessory sinus trouble so that the patient has a normal immunity, seems to the author just as laudable as an effort to secure a temporary immunity by inoculation:—simply a choice of endeavor. Shall we attempt to secure immunity through nature's channels or shall we attempt to secure immunity through laboratory products?

While I am not prepared to claim that more than 85% of hay fever and asthmatic cases have *determining* and *removable* nasal or accessory sinus factors, I would not be surprised if the future proved such to be a fact and that a failure to find these factors was because of a lack in our diagnostic ability.

Considering the varieties of pollens and proteid substances that *can* exert toxic influences on sensitive membranes, one is rather overwhelmed by the task of attempting to provide immunizing serums or remove *all* the noxious weeds and animals from the pathway of unfortunate subjects:

Amendments to state antiweed laws, to include the ragweeds that are estimated to cause 85% of autumnal hay fevers, is certainly to be recommended with double emphasis, but what shall be done with the hay pollens that become so abundant in the early summer? Our hay eating animals must have food,—still, by the enactment and enforcement of antiweed laws, so earnestly advocated by Dr. Schreppegrell, preventing the development each year of many useless pollen producing plants, a long step would be taken toward lessening the liability of having the air we breathe laden with irritants to the nasal membranes.

Until antiweed laws are operating effectively, inoculative methods are more perfected, or our physiologists have solved the mysteries of the adrenal system, work tending toward the restoration of normal membrane resistance seems rational and encouraging.

Personally I find myself willing to pursue this line of effort;—operations and treatments thus directed have been most satisfactory and I have enjoyed the consciousness at all times, that my every attempt was practically devoid of danger or of injury to the patient,—the whole problem being how best to restore nature's natural defense against irritating proteins.

Discussion.

Dr. Thomas J. Harris, New York City, reminded the Society that Dr. Snow was not the first to refer to the association of sinus disease to hay fever and asthma. This connection had frequently been pointed out. Selfridge of San Francisco had recently called attention to it, holding that cases where there is an associated sinusitis are not true hay fever, but pseudo-hay fever. Dr. Snow had frankly stated that his cases had not been tested out with pollens, and hence he did not know whether they were true hay fever. Selfridge had also studied the action, over and under, normal of the ductless glands, and had taken X-rays of the pituitary and other ductless glands. In addition to any pollen or any operative treatment he had used the glandular products.

Dr. Frank T. Hopkins, New York City, said asthmatic attacks were often due not at all to conditions in the nose but to septic conditions elsewhere. These cases were not seasonal, but continued more or less during the year. He cited the case of a man who had had asthmatic attacks for years. During the attacks he was very severely affected. It was noticed that he had some trouble with his teeth, and he was finally, with difficulty, induced to have his teeth removed. Pus cavities were found. The removal of the teeth and working on the gums cleared up the asthmatic attacks.

Dr. Snow, in closing the discussion, said the literature of the subject was omitted in reading the paper. He hoped that

a short-cut would be found in the treatment of these conditions with the unfolding of the mysteries of the ductless glandular system; in the meantime, he wanted to impress the fact that rhinologists and laryngologists could give these patients much relief pending the working out of these theories.

GANGRENE OF THE TEMPOROSPHENOIDAL LOBE, RIGHT SIDE, OF OTITIC ORIGIN—OPERATION AND EXTENSIVE EXCISION OF THE LOBE—WITH RECOVERY.

By JAMES F. McCAW, M. D., Watertown, N. Y.

The following case of chronic suppurative otitis media and gangrene of the temporosphenoidal lobe of the brain is such an unusual pathological condition that we feel justified in placing it on record by reporting it before this Society. The patient, a male aged 28 years, was brought to the Watertown City Hospital by his family physician on August 17th, 1914, with a history of having had a purulent discharge from the right ear for twenty years. His previous history revealed the fact that he had been a worthless, irresponsible, irritable, cruel fellow for years. He would do queer things so often that his family and neighbors had come to look upon him as not mentally balanced, and was always considered of very low mentality. After his marriage, he would wander away from home and be absent for several weeks without his family knowing his whereabouts. Would get up nights and go out to the barn and sleep in the hay mound, would treat his infant son cruelly and many other such unusual things as to be stamped by his fellow man as a moral and mental pervert. The chronic purulent otitis media had existed for twenty years, with acute exacerbations from time to time with great pain and discomfort lasting for several days, followed by increased discharge with relief of symptoms. On admission to the hospital, he had been suffering from one of these exacerbations for two weeks with gradual increase of symptoms, he complained of severe general headache as well as pain referred to the right ear, mastoid area, temporal region and chest, occasional nausea, and vomiting of small amounts of a greenish fluid, attacks of profuse perspiration and twitching of the facial muscles of the right side. Had lost considerable flesh. Examination: Patient

dull and apathetic, lies in a stupor unless aroused, but when aroused answers questions slowly and correctly but resents too much annoyance. The sensorium exceedingly lowered in tone when undisturbed but heightened when annoyed by the examination. There was no muscular paralysis, but occasional convulsive movements of the facial muscles of the right side. Aphasia was absent as would be expected; the lesion being on the right side. Ophthalmoscopic examination showed a dilated and immobile pupil with choked disc on the right side, and blurring of the left disc. The right auditory canal filled with foul smelling pus, tympanic cavity filled with cholesteatoma and necrosis of the ossicles and roughened bone in the attic, marked swelling and edema over the entire mastoid area, extending above the auricle and well forward over the temporal region. Extreme tenderness to pressure over the same areas. Temperature 99°, pulse 76, respirations 26. Urinalysis, sp. gravity 1030. trace of albumen and few hyaline casts. Differential blood count gave leucocytosis of 12000 polynucleeosis 82%, after the ordinary preparation the patient was operated upon the following day. The usual mastoid incision was made, the flaps elevated, the external table of bone looked somewhat dark; on removing the same and opening into the mastoid antrum there was a gush of greenish, exceedingly foul smelling fluid rising about two to three inches above the wound surface; there was about three to four ounces of this fluid evacuated. While there was very little free pus to be seen, there was a large quantity of infected foul smelling fluid and the entire bony structure of the mastoid was necrotic and soft. A complete radical mastoid operation was done, the infection was found to have gone through the tegmen antri which was necrotic of a cubriform appearance. The dura was uncovered at this point and was found to be of a dark greenish gangrenous appearance. My incision was then extended forward over the auricle and well into the temporal muscle; these flaps were elevated, and with Ronguer forceps the bony tables of the skull were removed over a corresponding area. The dura over this entire field was found to be

in the same greenish gangrenous state. Upon free incision of the dura and exposing the brain tissue beneath, it was found to be in the same condition of degeneration. With forceps and scissors the greater portion of the temporo-sphenoidal lobe was cut away, which was of the consistency of soft soap and of a greenish grangrenous condition throughout. There was no bleeding during this procedure. We purposely did not go into normal brain tissue for fear of opening up channels for further extension of the infection, but after removing as much as we felt warranted in doing, and separating the surfaces so as to get a view toward the center of the brain, we could see a shining glistening membrane which was thought to be the lateral wall of the lateral ventricle, and forward we could see and touch the posterior margin of the greater wing of the sphenoid. The distance by actual measurement was three inches directly inward and three and one-half inches forward from the surface of the wound. This wound was left open and loosely packed with iodoform-gauze except for two sutures in the temporal region. The patient stood the operation exceptionally well and at no time did he need stimulation. He was sent to bed and made an uneventful recovery. Contrary to the usual teaching, my first dressing was not disturbed until the fifth day, when it was taken down and the wound cleaned and repacked, this repeated every second day thereafter. The temperature chart showed that his pulse was never below 64 and that before operation, after operation it was never below normal. The temperature which had reached 102° before operation, never reached that point afterwards and was gradually seeking a lower plane until it became flat on the seventeenth day following the operation. Considerable pain in the head was complained of for about two weeks which had to be controlled by morphin. A fair sized cerebral hernia developed, but in the contraction of the wound due to the healing process, the greater part of it was taken care of. About two months after the primary operation, the wound was nothing more than a clean granulating surface with a small cerebral

hernia about one inch in all diameters situated in the region of the tegmen antri. A plastic operation was now done to give support to the hernia and close the wound. The flaps were elevated thoroughly and the entire wound curetted, a flap was fashioned from the posterior flap of the mastoid wound including the periosteum and overlying tissues except the skin, cut free at its lower part carried upward and forward and sutured to the periosteum at the upper and anterior part of the wound. This flap acting as a suspensory and covering to the hernia and giving it support. Another flap was made from the posterior auditory canal so as to enlarge the meatus and this was carried upward and backward being sutured to the upper part of the posterior wound flap thus giving further support to the hernia. The wound was then closed and iodoform gauze carried in through the meatus and the entire cavity lightly packed. The wound healed by primary union and the patient left the hospital eight days later. Subsequent history: The radical cavity had completely healed and was dry about six weeks after leaving the hospital. This patient's mental condition gradually improved and I heard through his employer about one year ago, that he was at that time a very good worker, trustworthy and dependable, had lost all of his former traits and was a real good citizen. There was no paralysis detectable and his mental and physical condition remains excellent. To me there are several points of extreme interest in this case.

First. It shows to what extent the brain can be involved in a pathological process without a fatal issue, and also the length of time such a process can be present without giving pronounced pathognomonic cerebral symptoms.

Second. It also illustrates the great tolerance of the brain to operative interference providing we do not go through healthy tissue in attacking the pathological process or go beyond the limits of the same opening up fresh channels for an extension of the infection. This is especially true in chronic conditions, for in these cases nature has already protected herself by walling it off from the general

cavity and if we do not heed nature's efforts but break down these barriers we are jeopardizing the welfare of our patient.

Third. The absence of free pus, none being found in any region. The infective agent must have gradually interfered with the blood supply to the temporosphenoidal lobe with final death of tissue. We conclude this from the fact that at the time of operation while freely cutting the lobe away there was no bleeding.

Fourth. The very marked improvement in the patient's physical, mental and moral status. From a mental and moral pervert he is restored to the community as a reliable and fairly good citizen, capable of earning his own living, whereas before, he was partly a county charge.

Fifth. The complete absence of any untoward symptoms following the operation and a gradual progressive and uneventful recovery. The pulse rate remained practically normal in the face of extreme intracranial pressure.

Sixth. My method of closing and giving support to the cerebral hernia by reinforcing its covering by two flaps before closing the mastoid wound, was most gratifying in its results, as it gave a firm solid retaining wall to the hernia which had remained so until the last time I saw the patient about a year after operation.

Discussion.

Dr. Edward B. Dench, New York City, has been particularly impressed with the change in the mental condition. He recalled the case of a man who had been operated on at the New York Eye and Ear Infirmary, in which there was a secondary operation six or eight weeks later for infection in the wound. The patient when seen by the speaker was irritable, appeared to be melancholic, and said he was dizzy. He was asked to send the man away from the clinic because he was unruly. He saw at once that the patient was very sick, and noted that he had some disturbance of equilibrium. After keeping him under observation for

several days the diagnosis of cerebellar abscess was made, and the cerebellum exposed in front of the sinus. The dura was incised, whereupon there was a spurt of cerebrospinal fluid, which drained for perhaps two minutes. The surface of the cerebellum looked perfectly normal. He did a decompression behind the sinus and explored the cerebellum in every direction, both in front and behind the sinus with negative results. He then sewed up the wound. The man was now out of danger, was walking about the ward, and was on the road to complete recovery. The change in his disposition since the operation was as marked as in Dr. McCaw's case. The cerebrospinal fluid contained no organisms. The case was one of simple serous meningitis.

Dr. George L. Tobey, Boston, Mass., reported a case similar to those cited. The man, who entered the hospital under Dr. Jack's service, in 1903, came under the category of "worthless." Dr. Jack operated, finding a temporosphenoidal abscess on the right side. The patient recovered, and has been seen at intervals. He had completely changed, had become a perfect family man, did not drink, and had become a member of the church.

Dr. Rae suggested that the condition in Dr. McCaw's case was probably chronic abscess. The variation in symptoms could be explained by the alternate filling up and discharge of such an abscess.

Dr. McCaw, in closing the discussion, had hesitated about presenting this case because he had not the specific data that he would like to have had, hence he merely reported the findings in hand. When he opened the antrum there was no free pus, as he understood the word. He did not regard the condition as a tumor; it was simply dead temporosphenoidal lobe tissue. There was no bulging, no unusual mass of tissue, nothing to indicate a new growth. The history of the case helped in determining this.

LATERAL SINUS THROMBOSIS.

By G. L. TOBEY, Jr., M. D., Boston, Mass.

This paper is not presented as a scientific thesis on the subject of lateral sinus thrombosis as a whole, but is simply a presentation of the observations and conclusions of the writer deducted from a large series of cases.

The terms Sinus Phlebitis and Sinus Thrombosis have apparently unconsciously become synonymous. While it is true that the latter is an advanced stage of the former, from an operative point of view they should be differentiated. As a matter of convenience I will use the term thrombosis in this paper.

It should be the aim of the surgeon to make his diagnosis and to operate during the stage of phlebitis, before advanced thrombosis has taken place.

While the accepted symptomatology is perfectly consistent with thrombosis with an already established general septicemia or pyemia it does not aid in the very early diagnosis of phlebitis which requires very careful clinical and laboratory observations.

A report of the following case is in point:

On May 21, 1919, I was called to see Mr. T. W. B. who gave a history of severe pain in both ears 12 hours. Both membrana were bulging and red. Double paracentesis followed by very profuse discharge of bloody serum. Culture showed staphylococcus aureus and short-chained streptococci. Directions were given for dry wicking and application of ice.

I was again called on May 27, six days later. Since the operation on the 21st, he had run a slightly irregular temperature, from normal in the morning to 99.6° or 99.8° in the evening. Occasional sharp shooting pains through both ears. Examination showed a very profuse serous discharge with marked infiltration of both membrana. No drooping of the canal walls. Slight tenderness on pressure over the

right antrum. Patient was immediately transferred to the Brooks Hospital. An X-ray of both mastoids was taken which showed slight involvement of the right mastoid with no breaking down, and a normal left mastoid. Owing to the X-ray findings it was thought advisable to keep the patient under observation.

During the next five days, up to June 1st, the temperature was above 99° but once, and at that time only 99.2°. On May 29 another X-Ray was taken and no change was found. Up to June 1st there was practically no discharge, the wick having to be renewed only twice daily. Tenderness over the mastoid entirely disappeared. There was, however, slight infiltration of both superior canal walls and an increasing infiltration of the drum membrane as a whole. On June 1st there was a slight tenderness and pain behind the right mastoid. No edema. The hearing reduced to six inches in both ears. Severe headache, preventing sleep the previous night. A white count showed 16,600 leucocytes, with 85.5% polynuclears, blood culture negative.

On June 2nd a double mastoid operation was performed. In the right mastoid the individual cells were found to be filled with very thin pus and granulation tissue. Exposure of the lateral sinus showed what was apparently a pyogenic membrane, although closely resembling broken-down blood clot. Exposure of the sinus being carried downward toward the jugular bulb revealed this condition throughout. There was no extension backward along the sinus. Removal of this membrane revealed no apparent involvement of the sinus wall, it being perfectly smooth and dark blue in color. In the left mastoid the cells were found to be filled with thin pus, but no apparent encroachment on the lateral sinus. There was a good recovery from ether.

During the next four days patient complained of intermittent headache localized through the eyes and through the temples. Middle ears dry on the 3rd day. Temperature, however, continued to be slightly irregular, varying from normal to 99.4° or 99.6°. No chills, no sweating, no nausea, no vertigo. In fact there is no complaint other than

the intermittent headache which interfered with sleep. Slightly relieved by 10 grains of asperin or 5 grains of phenacetin. Blood culture on June 4th was negative.

In the morning of June 7th temperature was 99°, but he complained of having had severe intermittent headache during the night. That evening the temperature was 101°; no chilly sensations, no sweating. Patient felt perfectly well other than diffuse headache. Examination of the blood at this time showed 9,400 white cells, 69% polynuclears, blood culture negative. On June 7 removal of mastoid dressings showed the wounds to be clean and granulating well, both middle ears dry.

On the morning of June 8 the temperature was 101°, white count 13,200, with a polynuclear 88.5%, blood culture negative. Owing to the continued headache which had been severe during the previous night spinal puncture was done, and 12 c.c. of fluid removed. This was apparently under pressure, was clear, colorless, and did not clot. Examination showed a cell count of .5, the Noguchi slightly positive, the Ross-Jones test also slightly positive. Physical examination otherwise negative.

We were now confronted with the question of diagnosis. We had a man, double mastoiditis performed 8 days previous, having run a slightly irregular temperature never above 99.2° until the previous evening, complaining of intermittent headache, having had no chills, no sweats, and no disturbance of the reflexes, normal eyes, and yet has a slightly varying leucocytosis with at the present time, a polynuclear count of 88.5, spinal fluid under slight pressure, but clear, who shows a cell count of .5, with a slightly positive Noguchi test. A provisional diagnosis of beginning sinus phlebitis was made. Owing to the findings at the mastoid operation as previously described, the right lateral sinus was explored. After blocking the sinus an incision at the knee revealed a definite demonstrable mural thrombus. The jugular vein was immediately ligated above the facial. A complete opening of the lateral sinus was then carried out and the mural thrombus was found to extend practically

to the jugular bulb. This was removed and the wound packed. On June 10th the white count was 9,400, with 72% polynuclears, temperature normal in the morning, 99° in the evening, blood culture negative. No headache and patient comfortable.

On June 11 temperature was normal, and has continued below 99° to date.

The terms "typical" and "atypical" as applied to cases of lateral sinus thrombosis should be discarded from the literature, since they are most misleading, not only to the beginner but to the older otologists who are not meeting with a large number of these cases. I feel justified in making the statement that the textbook so-called "typical case" is very rare, and the otologist must be taught that each case is a problem unto itself, and that the picture is rarely complete. Many deaths have undoubtedly been caused by the fact that the text book diagnosis is apparently so simple, and the consulting otologist is repeatedly called to see cases *in extremis,* where a clear understanding on the part of the local physician or otologist of the obscure symptoms to be observed would have resulted in an early diagnosis.

A history of existing or pre-existing middle ear suppuration is the rule, although the otitis media may have been so slight as to cause no perforation of the drum membrane, the middle ear returning to normal within a few days, and yet give rise to a supervening mastoiditis. This is not a rare occurrence and does, I think, account for many of the cases of so-called "primary mastoiditis."

For purposes of mental classification we may divide the cases into two groups; the one which may be termed the *septic explosive* type, in which cases the symptoms are most violent from the very onset and the patient is evidently suffering from a very acute infection; secondly, what might be termed the *typhoidal* type, in which cases there is an apparently low-grade infection and where the differential diagnosis is relatively difficult, and arrived at only by very careful exclusion.

In the general consideration of the symptomatology there are four distinct types of temperature charts:

Type A.—The accepted picture of acute sepsis with very sudden elevation of several degrees and equally sudden remissions to normal, or even subnormal. This may occur several times within a few hours, or but once or twice during the twenty-four. I have seen several cases where it has occurred at intervals of at least 36 to 48 hours, the result being a perfect malarial chart.

Type B.—The temperature at no time showing an elevation of more than one or two degrees but a persistent irregularity, with a usual evening rise, although it may vary several times during the twenty-four hours.

Type C.—An elevation of two to three degrees, which does not remit to normal but shows sl. remissions and elevations from 100° as a basis. This may persist for several days, and then return to normal. This type nearly always recurs after remaining at normal for a few days.

Type D.—It is not an uncommon experience to find a definite sinus thrombosis, and occasionally a broken-down sinus wall and fistula, in doing the mastoid operation, the temperature chart having at no time shown any temperature whatsoever. In a series of 73 cases this occurred 11 times, in three cases the sinus wall having been completely necrosed.

The pulse usually follows the temperature and has been found of little diagnostic value.

This great variation demonstrates clearly that the temperature cannot be considered a definite diagnostic symptom. Its presence indicates infection, but its absence or its atypical characteristics do not preclude an infectious thrombosis of the sinus.

The temperature chart must, however, always be taken into consideratioon in forming the conclusions as to diagnosis.

In the textbooks great stress has been laid on the presence of chills. True rigor occurs in less than 50% of the cases. A large majority will complain of fleeting chilly

sensations, accompanied by sweating. This is not, as a rule, volunteered by the patient, but is brought out by inquiry. A common occurrence when making a visit is to find the patient's nightclothes moist, or even saturated, and on inquiry the patient says that he has occasional "hot flashes".

The latter is often overlooked yet is most suggestive of infection.

Seldom is the headache described as pain, rather it is a dull sensation of pressure which the patient is unable to definitely localize. This is accompanied by drowsiness from which one is readily aroused, but which immediately recurs, suggesting a typhoidal picture.

The toxemia has a peculiar characteristic in that there are intermittent periods of exhilaration and feeling of well-being, followed by periods of depression.

Optic neuritis or choked disc may be present in a small percentage of cases (10% to 11%) due to meningeal irritation, and infection, or from extension of the thrombus and consequent blocking of the petrosals, or even involvement of the cavernous sinus.

A more common nerve lesion is paresis of the sixth. This latter is toxic in origin, and not infrequently found in acute suppurative otitis media.

A serous meningitis with a positive Noguchi and Ross-Jones has been observed several times.

In a series of over 100 cases the average leucocytosis was 15,000, with a polymorphonuclear percentage of 78. The leucocytosis is of value only when taken into consideration with the other symptoms present, and when taken in series.

Blood Culture.

Too much emphasis has been placed on the value of the blood culture as a diagnostic sign of the presence or absence of sinus infection. When positive it is an indication of infection and when taken into consideration wth the other symptoms present is an aid in the diagnosis, but it must be borne in mind that it may be positive in practically every acute infection—as pneumonia, tonsillitis, acute endocarditis, erysipelas, etc. A negative culture does not preclude the

presence of infection, since it may be negative today, positive tomorrow, and again negative on the following day.

Edema or infiltration, with tenderness on deep pressure over the area drained by the mastoid emissary vein, was the most constant objective symptom which was found present in a large series of cases, and was present in practically every case of mural or complete thrombosis of the sigmoid sinus. This sign or symptom is quite distinct, and readily differentiated from mastoid edema and tenderness, and, per se, never extends forward over the posterior border of the mastoid.

The same symptom or sign is found just below and posterior to the mastoid tip from blocking or infection of the posterior condylar vein which enters the sinus, as a rule, just before it forms the jugular bulb. (This vein is not constant).

Sufficient emphasis has not been placed on this symptom in the past.

This sign may be found as a result of perisinus abscess, and in perforation of the cortex. Enlargement of the external jugular on the same side is not infrequently observed. As to the value of this observation, I am unprepared to state, yet it may be borne in mind in a case of double mastoiditis with other symptoms of infectious thrombosis.

I have never been able to find demonstrable signs in the examination of the neck—as tumor, or tenderness along the jugular vein.

Since a large extra-dural or perisinus abscess will, in a certain number of cases, simulate symptomatically a thrombo-phlebitis, the mastoid operation should be performed, and in every case the sinus should be exposed before ligating the jugular.

Undoubtedly there is concomitant direct infection of the endothelial lining of the sinus with, mayhap, a slight parietal thrombus formation. Having found, however, that the majority of such cases receive immediate and permanent relief by drainage of the extra-dural abscess, it is my practice not to interfere with the sinus or ligate. in the

absence of a demonstrable necrosis of the sinus wall, or very marked evidences of septicemic or pyamic symptoms. Should subsequent developments demand the sinus operation may be performed.

Anatomically, the type of mastoid apparently plays no important role. Sinus infection found in cases showing few, if any well-developed mastoid cells, with the lateral sinus infringing on the antrum and posterior canal wall, suggests this as an etiological factor, yet in the large number of this type of mastoid encountered the percentage of sinus infection is no greater than in the broad, deep, well developed mastoid process.

Prognosis.

It is impossible to make a definite statement as to the prognosis of this condition since death is due, in all cases, to an intercurring or supervening complication and not from infection of the lateral sinus per se. In considering the prognosis each case must be taken as a unit.

A review of the causes of death in twelve cases shows two from cavernous sinus thrombosis; six cases of septic meningitis; three cases of temporosphenoidal abscess; one case of cerebellar abscess.

The prognosis, as influenced by ligation or resection, is equally hard to determine. We do know, however, that practically 90% of the cases of simple ligation recover but, on the other hand, there are a tremendous number of unrecognized or unoperated cases which recover after a longer or shorter course, with or without pyemia.

The following case is a startling demonstration. A lumberman, isolated in a logging camp in northern Maine, was taken with acute otitis late in November, 1914, followed by six to eight weeks of prostration accompanied by repeated severe chills and sweats, tremendous swelling and tenderness behind and about the ear, with a very profuse aural discharge. These symptoms gradually subsided under no treatment other than that of nature. His strength gradually improved, and he was able to return to light work at the end of about ten weeks. There were at no time any evidences of metas-

tatic infection. He left the woods late in May and was referred to me on account of a persistent purulent discharge from the ear, otherwise he considered himself perfectly well. On examination the middle ear was found to be normal, the spoken voice being heard at forty feet. On the posterior canal wall, about 2 cm. external to the drum membrane, there was a very small nipple. A small silver probe was passed through this nipple for at least two inches, directly backwards. Its removal was followed by a drop of thick, creamy pus. The X-ray showed a completely broken-down area extending posteriorly over the sinus and cerebellum. There was no tenderness and no edema. Temperature normal. Operation on the same day revealed a completely broken-down mastoid walled off from the antrum, the lateral sinus from behind the knee to the jugular bulb exposed covered with granulations, and for over an inch the outer wall of the sigmoid portion had completely necrosed, the lumen of the vessel being the seat of a septic broken-down mass. Thick granulation tissue extended for at least an inch posteriorly to the sinus over the cerebellum. Light curettage and free drainage was followed by complete recovery in three weeks. The jugular vein was not ligated since there were no systemic symptoms present at the time or subsequently.

Operative Treatment.

If, owing to the previous subjective and objective symptoms, or if the conditions found at the mastoid operation indicate the possibility or probability of sinus infection, the lateral sinus should be exposed. The bony wall covering the sinus should be removed by means of a chisel, sharp spoon curet, or rongeur. No definite steps of technique can be laid down since the contour and the conditions present differ in each case, and the technique of the individual operators varies.

As a general principle, however, in the cases where the sinus is not exposed by disease, the knee of the sinus seems to be the point of election for the original exposure. I have found the use of a sharp gouge or the spoon curet to be

the safest. In this way the bony covering may be gradually taken off without the danger of perforation of the sinus wall, and by this means no small sharp spicules of bone are driven into the wall of the sinus.

A small exposure having been made, it is readily enlarged, either by the introduction of a curet between the sinus wall and the bone, (the sharp spoon of the curet being outward,) or by the introduction of a small right-angle rongeur.

In the use of the rongeur care must be taken that the wall of the sinus is not nipped between the lip of the instrument and the bony wall. This is not an uncommon accident.

The bone should be removed over the sinus downward and forward toward the jugular bulb, and backward from the knee toward the torcular.

I have made it a rule, where there is a question of sinus infection of exposing the emissary vein when feasible, and of removing the bony wall of the lateral sinus beyond the edge of the sinus on each side. Injury of the sinus is most common in removing the bone just beyond the knee where the sinus wall is usually in very close contact with the cortex, and, secondly, at the lower end of the sigmoid portion, just above the jugular bulb. At this point one is working at a difficult angle.

In cases where disease has destroyed a portion of the sinus wall the remaining bone should be carefully removed by means of the curet and rongeur, exposing the sinus wall backward for at least one-quarter to one-half an inch beyond the evident involvement, and it also should be removed below as far as possible to the jugular bulb.

The sinus wall itself should now be very carefully investigated. The presence or absence of a necrotic area in the sinus wall should be determined. In the absence of a definite fistula through the wall it is absolutely impossible to make a definite statement as to the presence or absence, or type of infection or pathological change which may have taken place within the sinus itself.

I have discarded the use of the test puncture since it is most unreliable; and there is the added danger that the needle may, in the presence of a partially collapsed sinus, be passed through the dura, with a resultant infection.

I have many times demonstrated the presence of mural thrombi by making a small incision in the sinus wall, using a very sharp knife and very slowly cutting through the wall of the vessel and, on incising the endothelial layer, have demonstrated the presence of blood clot.

The thrombosis of the vessel has also been demonstrated by opening the emissary vein, having first passed a ligature around this vein proximal to the point of opening, and passing a small sterile silver probe into the lumen of the sinus. The use of this probe is necessary since the valve-like opening of the emissary vein into the sigmoid sinus often prevents the flow of blood from the sinus into the vein.

The most satisfactory and conclusive method is that of free incision of the sinus wall. Pressure is applied between the cortex and the sinus toward the jugular bulb. An incision is then made through the wall, care being taken that the inner wall of the sinus is not injured. The lumen of the vessel is then readily explored. The sinus wall having been incised, the lower plug may then be loosened to demonstrate the presence or absence of obstruction in the bulb. The same procedure is carried out at the upper end of the incision.

A positive diagnosis of involvement of the sinus being present, we should immediately proceed to cut off the direct communication of the sinus with the general blood stream. It seems to be a most mooted question as to just what procedure should be undertaken under these conditions. On the one side there is the relatively conservative, simple ligation of the jugular vein; on the other, the more radical excision. Statistics bear me out in saying that simple ligation is the logical operation, bearing in mind that it is necessary in a small percentage of the cases to proceed with complete excision of the vein.

In over 200 cases it has been found necessary, owing to extension of the infection in the jugular below the facial vein, to resect in only two cases.

In favor of simple ligation we have first, the relatively few cases requiring complete resection; secondly, the very short time required for the operation, (ten to fifteen minutes,) with the consequent small amount of shock to the patient, non-exposure of the tissues of the neck to infection, the very small, insignificant scar; and finally, the ultimate results as shown by definite statistics.

The disadvantages of resection, on the other hand, lie first, in a much more extensive operation, requiring in the average hands a long period of time with the consequent added shock to an already very sick patient; secondly, the opening up of a tremendous area to infection; thirdly, the resultant, in many cases, unsightly scar, (and I do think that the esthetic should be taken into consideration when possible and safe;) fourthly, statistics and careful observation over a very large series of cases has shown that this extensive operation is unnecessary except in a very small percentage of cases. I am not making the statement that resection of the jugular vein is not necessary, but I do say that it should not be done unless it can be definitely demonstrated that septic thrombosis has extended below the point of election in ligating.

Technique of Ligation of the Jugular Vein.

The point of election for ligation is the superior carotid triangle, and at about the level of the thyroid cartilage, above the junction of the facial vein; this allows the facial vein an opportunity to aid in establishing the collateral circulation.

My procedure in recent cases has been to tie high, first outlining the natural transverse folds of the skin below the jaw, with the chin in the median line, and making a small incision one to one and one-half inches in the long axis of one of the deepest depressions. The head is then turned to the opposite side and a small sandbag placed under the shoulders, thus giving a slight extension of the neck. In-

cision is then carried through the platysma muscle, a curved Mayo scissor is then inserted just in front of the sterno-clydo mastoid muscle, and by means of dry dissection the carotid sheath is readily brought into view. The deep dissection is carried on until the facial vein is demonstrated. A double number one chromized gut ligature is then passed around the vein just above the facial. These two ligatures are then separated for about one-half an inch, and by the use of traction the lumen of the vessel between the ligatures may be alternately opened and closed, and the patency or obstruction readily made out.

When the vessel is evidently patent, the proximal ligature is first tied, (that is the one nearest the jugular bulb). The distal ligature, the blood having been expressed from between, is next tied. The ligatures being cut, the vessel is dropped back into place, one or two interrupted catgut sutures are taken in the superficial fascia, the skin is then closed with two or three horsehair sutures, and a collodian dressing is applied.

Many operators advocate cutting the vessel between the ligatures. I can see no advantage in this procedure, and it opens an avenue for direct infection of the deep tissues of the neck, especially in the presence of a positive blood culture, or in the presence of a slight infection of the endothelial lining of the vein. Certainly, nothing is gained by this procedure, and it should be discarded as unnecessary and dangerous.

Should the jugular vein be found to be unquestionably thrombosed and infected, as occasionally occurs, the operator may simply extend his operation and do a complete resection. The jugular having been ligated or resected, we pro ceed with the lateral sinus operation.

The plug at the lower end of the sinus is removed and in the presence of free hemorrhage, which demonstrates a patent inferior petrosal and condylar vein, this plug is immediately replaced, and nothing further done at this time. In the absence of free hemorrhage, however, the bony sinus wall must be removed downward and backward as far as

possible, to give access to the jugular bulb. I find that sufficient exposure is obtained without the radical procedure of Grunert. A small curet (one with a malleable handle being preferred) is then used to remove the clot of broken-down thrombus from the bulb, in so far as possible. Very frequently during this procedure free hemorrhage from the petrosal results. Should no free hemorrhage be obtained a small gauze wick, plain or iodoform, is passed into the cavity. The plug is then removed from the upper end of the sinus in the region of the knee. The membranous sinus wall and the bone overlying should be entirely removed to a point beyond the presence of demonstrable thrombosis, the removal of the bone always preceding slightly the removal of the membranous portion of the sinus.

A procedure which I have used considerably is that of trephining the cortex over the lateral sinus, from one to one and one-half inches posterior to the knee, and beyond the superior petrosal sinus, and shutting off the blood stream by pressure with a small roll or plug of gauze placed between the cortex and the dura. By this means, free exploration of the sinus wall up to and in the presence of thrombosis of the superior petrosal, even beyond this vessel, is facilitated. By this means a thrombus is formed by a back pressure which has no direct communication with the infected thrombus Should, however, the infection be found to extend posterior to the point of exposure, another exposure may be made further back. In this way we have a control, not only of the tremendous hemorrhage incidental to the primary removal of the thrombus, but we also have a control of hemorrhage at the first few subsequent dressings. This plug may be left in situ for five or six days. The opening is then readily closed and leaves practically no scar.

I will report a case demonstrating not only the value but even the necessity of this procedure, the patient nearly losing his life because I did not follow out this technique.

An iodoform or plain wick is then passed along the trough of the exposed sinus and a light gauze packing is placed in the mastoid cavity. This dressing is changed if no untoward

symptoms intervene at the end of four or five days. The wick is removed from the jugular bulb region, if clean, another wick is inserted. Should there be a slight amount of pus this is readily removed with irrigation. The wick is also changed at the upper end of the sinus at this time. The pressure is relieved from the accessory plug and if no hemorrhage occurs this is permanently removed at this time; otherwise it is left in situ until the next dressing, two days later.

Should there be a continuation or recrudescence of the septic symptoms we must consider first, the question of metastasis before ligation; secondly, secondary infection of the neck at the point of ligation or resection; thirdly, infection in and just below the jugular bulb; fourthly, extension of septic thrombosis toward the torcular; fifthly, intercurrent acute infections; sixthly, iodoform poisoning, if iodoform was employed in the dressing.

Physical signs of a small metastasis which has occurred before or immediately after ligation may be delayed for several days. The first symptoms being those of sepsis, with a beginning localized tenderness at some distant point. The common location is in the body of the long muscles, especially in the calf of the leg. When it occurs in one or more of the joints, a careful differentiation with acute arthritis must be made, since we may have an intercurrent true arthritic infection. Metastases in the lung are fortunately rare, but must always be considered under these conditions. I shall refer later to a case of the subacromial bursitis following sinus infection. Secondary deep infection of the neck following ligation where the wound was closed occasionally occurs. I have seen several cases where no objective evidence indicating a neck infection could be found for two or three days after the septic temperature had occurred or recurred, free drainage immediately relieving the temperature.

The statement has often been made in meetings, and I have also found it in print, that in simple ligation without removal of the jugular bulb and vein that we are leaving a large sack of pus which does not have free drainage, the reason

given being that pus does not readily drain uphill. I think that the men making this statement have neglected to consider the fact that their patients during this stage of the disease are in a recumbent position, and that, as a matter of fact, the upper opening of the jugular bulb is the most dependent portion involved. Statistics most certainly do not bear out the contention that this is a dangerous procedure. I have, however, in a number of cases with a recurrence of septic symptoms, found the bulb and the vein immediately below to be filled with fluid pus, which was readily removed by means of douching with a very small, fine catheter inserted along the course of the vessel. Seldom has it been necessary to repeat this procedure more than two or three times.

Another complication of the convalescence is that of extension of the thrombus and infection along the venous channel toward the torcular. This condition is not, as a rule, accompanied by marked signs of sepsis, the typical picture being one of increased apathy on the part of the patient, complaint of dull, heavy headache on that side, with occasional increasing signs of intracranial venous congestion or pressure. I have twice found it necessary to open the sinus as far as, and even into the torcular itself. Fortunately the anatomical structure of the torcular, precludes the probability of direct extension of the thrombus into the opposite sinus. In speaking of the mental hepitude and evidence of intracranial congestion as a complication one must bear in mind the possibility of the absence or a poorly developed sinus on the opposte side.

The most frequent complication simulating a symptomatology of sinus thrombosis is a localized central pneumonia. In children and in adults a small area of central pneumonia may be in existence for several days, giving rise to a typical septic temperature with chills, the physical signs not appearing for 72 or 96 hours.

Erysipelas must be taken into consideration, especially the type which gives evidence of sepsis for several days before local objective signs occur. We must also bear in mind the

question of malaria, acute tonsilitis, acute arthritis, the focal infections, etc. I will refer later to the occurrence of acute prostatitis and acute pyelonephritis occurring as a complication with a concurrent sinus infection.

The frequent use of iodoform as a dressing has led to occasional cases of acute iodoform poisoning. The onset is very acute, usually ushered in with severe chill, and temperature of 102° to 104°, profuse sweating, and running a definite septic temperature chart. The local manifestations, such as marked redness and swelling, which embrace the whole auricle and the region about the wound would lead one to suspect the source. This readily subsides on the thorough removal of the iodoform.

A very unusual and rare complication is the occurrence of a septic sinus thrombosis on the other side. I have but one authentic case of this condition in which one jugular was tied, with complete opening of both lateral sinuses, and ultimate recovery.

The following case illustrates some of the difficulties encountered in making a diagnosis, and also the complications and accidents which may occur during the course of the disease.

A. R., 55 years of age, was referred to me on January 18, 1919, with a history of influenza late in December. A persistent bronchitis has persisted to date, accompanied by cough and moist, coarse rales. On January 10 he was taken with an acute otitis media, and the drum membrane was freely incised at this time. A profuse purulent discharge has persisted to date. Pain and tenderness over the antrum, four days. On physical examination found a fairly well-developed man evidently in poor physical condition subsequent to influenza. There was a persistent cough accompanied by the expectoration of considerable thick mucoid secretion, numerous moist bronchial rales, temperature 98.8°, a marked tenderness over the mastoid on deep pressure, profuse mucopurulent discharge from the middle ear, superior and posterior canal wall slightly infiltrated, urine neg-

ative, leucocyte count 17,000. Owing to the presence of the bronchitis immediate operation was not thought advisable.

On January 22, however, owing to the increased tenderness and slight edema posterior to the mastoid, increasing drooping of the canal wall, and frontal headache, operation was imperative. A simple mastoid operation was performed under light anesthesia, and, as has occurred following the influenza, the individual mastoid cells were not completely broken down but each individual cell found to be filled with pus and granulation tissue. A small area of the sinus was exposed just below the knee, the wall being apparently normal. Following the operation there was retention of urine, tremendous distention of the abdomen with acute distress and belching of large quantities of gas. The ether apparently had no ill effects on the bronchial condition. On the 22nd it was found necessary to catheterize. High enemas gave no apparent relief to the abdominal distention and discomfort.

On January 24 patient complained of pain in the pelvic region, also in the right upper iliac, accompanied by abdominal tenderness. During the night of January 24 and 25 patient's temperature was 102°, pulse 115, with no change in the respiration.

Temperature varied from 102° to 104° during the day of the 25th. No evidence of pneumonia could be found. There was evident marked putrefaction throughout the whole intestinal tract, associated with a tremendous amount of gas and distention. The pain and tenderness in the pelvic and right iliac region persisted, requiring small repeated doses of morphia.

During the night and day of January 26 the temperature varied from 100° to 104°, irregular in character, the pulse varied from 110 to 140, respiration 30. At this point, in consultation, the following conditions were taken into consideration: We have a patient with very evident marked putrefactive process throughout the intestinal tract, accompanied by gas and distention, the medical consultant saying that this condition is sufficient to give rise to all the subjective

and objective symptoms present. A consultation with the urologist reveals a right acute pyelonephritis and an acute prostatitis, which conditions might give rise to much more evident septic symptoms than are present. The white count was 14,600, blood culture negative, the mastoid wound clean, granulating well, and the middle ear dry. There is no headache, no tenderness in the neck. Are we or are we not dealing with a beginning infection of the lateral sinus?

In view of the conditions present and the opinions of expert medical and urological consultants nothing was done in regard to the ear. Following out the instructions and treatment as outlined by the medical consultants the temperature returned to normal on January 30, patient apparently in relative comfort.

On the morning of January 31, a few minutes after entering the hospital, I was hurriedly called to the patient's room. On arrival I found practically everything saturated with blood. Following a spasm of coughing there had been an evident rupture of the lateral sinus which had immediately saturated the dressings and poured over the bed and bedclothes. I immediately tore off all the dressings, ripped the wound wide open with my fingers, and packed with gauze. This immediately controlled the hemorrhage, although the patient was in apparent shock from fright and loss of blood; and that afternoon the temperature rose to 102°, the pulse to 120. Immediate ligation of the jugular at the time of the accident not being advisable, owing to the condition of the patient, I ligated in the evening of the same day, January 31. Blocking off of the sinus and incision of the wall revealed a very free hemorrhage from above the knee, and complete obstruction toward the bulb. The secondary blocking off of the sinus posterior to the knee, as I have advocated, was not carried out, since time was of prime importance. Following the ligation the temperature returned to normal within 12 hours, and remained normal for six days when, on February 6, patient complained of very severe pain and tenderness in the region of the right subacromial bursa, with marked limitation of motion. The

question immediately arose, are we dealing with a metastatis or a toxic bursitis? The mobilization of the shoulder gave considerable relief. It was decided that it was of toxic origin without formation of pus.

On February 14 a plaster cast was applied. At the subsequent dressings of the mastoid wound and of the lateral sinus there was tremendous hemorrhage from the posterior portion of the sinus at every dressing over a period of two weeks. This would have been obviated had the secondary blocking been employed.

Following the final thrombosis of the sinus posteriorly the patient made an uneventful recovery with, however, some limitation of motion of the arm.

This case demonstrates the difficulties in making a definite diagnosis in the presence of intercurring complications, the occurrence of an unusual accident in the rupture of the sinus wall due to coughing, the persistent hemorrhage following opening of the lateral sinus, and the occurrence of a toxic bursitis without metastasis.

Discussion.

Dr. Edward B. Dench, New York City, congratulated Dr. Tobey upon his technic; he had made ligation a very simple operation. This had not been the speaker's experience. He always took out the jugular, because he had always found glands at the angle of the jaw that made it difficult to get a ligature around the jugular above the facial vein. He was glad Dr. Tobey had made the distinction between phlebitis and thrombosis. There might be complete absence of bacteria in the blood stream, when the sinus was completely blocked. It was when the clot had broken down or was still parietal that a positive blood culture was present. He did not see how Dr. Tobey could make the diagnosis of thrombosis and operate without more change in the temperature than in some of the cases reported, and in the absence of a positive blood culture. He agreed with Dr. Tobey as to chills, which were noted in very few cases.

Sweating was very common. He had not found the dizziness mentioned by Dr. Tobey. As a rule the patient's general condition was good, and the mental condition likewise.

He had found that the globulin test would almost invariably be positive when the dura was exposed, either by disease or by operation. It would be positive from a simple exposure of the dura.

Almost every case had a little tenderness at the angle of the jaw, due to glandular involvement, and that was one reason why he preferred excision.

He had seen only four or five cases in which the sinus had been completely obliterated by disease in chronic cases and once in an acute case, or rather, an acute exacerbation of a chronic case.

Dr. R. Bishop Canfield, Ann Arbor, suggested a method of handling the lower end of the upper portion of the jugular vein in cases in which it has been necessary to ligate. After passing one ligature around the vein below the lower level of the thrombus he picks up the vein above the ligature with a hemostat, sections the vein between ligature and hemostat, inserts a small wick of gauze into the upper fragment of the vein, passes a ligature around the vein containing the wick and with this ligature sutures this portion of the vein to the skin incision. A few days later the wick is removed without disturbing the ligature. This gives opportunity to wipe out the upper end of the vein as far as the base of the skull or even to irrigate through between the mastoid cavity and neck wound if the bulb contains an infected clot.

Dr. Tobey, in closing the discussion, presented forceps which he used for handling the jugular.

He did not agree with Dr. Dench regarding the globulin test. He had tried it out repeatedly. He had found it very simple to expose the jugular. In every case with acute infection, even in acute otitis media, he had noted the tenderness at the angle of the jaw. This was of no significance

as to the presence or absence of infection in the vein itself.

Referring to Dr. Canfield's suggestion, he had once brought the upper end of the vein into the wound, using it as a drainage tube. He had found no necessity for this procedure; he simply did it as an experiment. The main point was to operate early. He recalled one man who had had numerous operations. He had had his lungs, joints, etc., opened up, and he was nothing but skin and bone. One case like that would teach one to litigate the vein as early as possible.

TRANSACTIONS

OF THE

AMERICAN OTOLOGICAL SOCIETY,

FIFTY-THIRD ANNUAL MEETING.

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1906—Dr. E. Terry Smith	36 Pearl St.	Hartford, Conn.
1909—Dr. S. MacCuen Smith	1429 Spruce St.	Philadelphia, Pa.
1906—Dr. Sargent F. Snow	707 University Block	Syracuse, N. Y.
1909—Dr. Selden Spencer	2725 Washington Ave.	St. Louis, Mo.
1904—Dr. Franklin M. Stephens	19 West 54th St.	New York, N. Y.
1910—Dr. Joseph A. Stucky	Fayette National Life Bldg.	Lexington, Ky.
1914—Dr. Edward Blair Sutphen	162 South St.	Morristown, N. J.
1886—Dr. Theron Y. Sutphen	999 Broad St.	Newark, N. J.
1901—Dr. Lewis H. Taylor	82 South Franklin St.	Wilkes Barre, Pa.
1912—Dr. J. J. Thomson	3 Park Ave.	Mt. Vernon, N. Y.
1914—Dr. George L. Tobey	416 Marlborough St.	Boston, Mass.
1906—Dr. Ernest de Wolfe Wales	605 Hume-Mansur Bldg.	Indianapolis, Ind.
1906—Dr. D. Harold Walker	390 Commonwealth Ave.	Boston, Mass.
1906—Dr. Joseph A. White	200 East Franklin St.	Richmond, Va.
1891—Dr. Edward Wheelock	26 Gibbs St.	Rochester, N. Y.
1896—Dr. Fred Whiting	19 West 47th St.	New York, N. Y.
1912—Dr. John Gordon Wilson	104 S. Michigan Ave.	Chicago, Ill.
1899—Dr. Hiram Woods	842 Park Ave.	Baltimore, Md.

HONORARY MEMBERS
(Deceased)

Dr. E. H. Clarke
Dr. Edw. L. Holmes
Dr. Herman Knapp
Dr. A. F. Mayer
Dr. E. Williams

MEMBERS
(Deceased)

Dr. Frank W. Abbott
Dr. John L. Adams
Dr. C. R. Agnew
Dr. W. F. Akin
Dr. H. P. Allen
Dr. Edwin W. Bartlett
Dr. Clarence J. Blake
Dr. Charles H. Burnett
Dr. John P. Davidson
Dr. J. H. Dix
Dr. E. Dwyer
Dr. E. P. Ely
Dr. Edward Fridenberg
Dr. Blancome E. Fryer
Dr. John Green
Dr. Emil Gruening
Dr. Neil J. Hepburn
Dr. James Hewitt
Dr. Christian R. Holmes
Dr. Edgar M. Holmes
Dr. Joseph A. Kenefick
Dr. Gordon King
Dr. Charles J. Kipp
Dr. Alfred F. Koetter
Dr. D. Braden Kyle
Dr. J. W. Lawton
Dr. W. S. Little
Dr. C. J. Lundy
Dr. Stephen H. Lutz
Dr. G. Hudson-Makuen
Dr. Read J. McKay
Dr. Horace J. Miller
Dr. W. W. Moreland
Dr. James E. H. Nichols
Dr. Henry D. Noyes
Dr. J. F. Noyes
Dr. Oren D. Pomeroy
Dr. Barton H. Potts
Dr. Wm. Rankin, Jr.
Dr. J. M. Ray
Dr. Stephen O. Richey
Dr. Charles E. Rider
Dr. F. W. Ring
Dr. Arthur W. de Roaldes
Dr. Wm. K. Rogers
Dr. D. B. St. John Roosa
Dr. Wm. W. Seely
Dr. Henry L. Shaw
Dr. Edmund D. Spear
Dr. Frank Sprague
Dr. Samuel B. St. John
Dr. George Strawbridge
Dr. William Thompson
Dr. Robert Tilley
Dr. J. J. B. Vermyne
Dr. Frederick M. Wilson

FIFTY-THIRD ANNUAL MEETING

of the

AMERICAN OTOLOGICAL SOCIETY.

Held at the Boston Medical Library, Boston, Mass., Monday and Tuesday, May 31st and June 1st, 1920.

The following members and guests registered during the meeting:

Members.

DR. EMIL AMBERG	Detroit, Mich.
DR. JOHN F. BARNHILL	Indianapolis, Ind.
DR. HERBERT S. BIRKETT	Montreal, Canada
DR. HUGH B. BLACKWELL	New York City
DR. CHARLES R. C. BORDEN	Boston, Mass.
DR. WM. C. BRAISLIN	Washington, D. C.
DR. EUGENE A. CROCKETT	Boston, Mass.
DR. EWING W. DAY	Pittsburgh, Pa.
DR. L. W. DEAN	Iowa City, Ia.
DR. WELLS P. EAGLETON	Newark, N. J.
DR. FRANCIS P. EMERSON	Boston, Mass.
DR. HARRY FRIEDENWALD	Baltimore, Md.
DR. MAX A. GOLDSTEIN	St. Louis, Mo.
DR. THOMAS H. HALSTED	Syracuse, N. Y.
DR. PHILIP HAMMOND	Boston, Mass.
DR. THOMAS J. HARRIS	New York City
DR. WILLIAM H. HASKIN	New York City
DR. R. JOHNSON HELD	New York City
DR. FRANK T. HOPKINS	New York City
DR. THOMAS HUBBARD	Toledo, Ohio
DR. FREDERICK L. JACK	Boston, Mass.
DR. ISAAC H. JONES	Los Angeles, Calif.
DR. GEORGE E. LELAND	Boston, Mass.
DR. ROBERT LEWIS	New York City
DR. JAMES E. LOGAN	Kansas City, Mo.
DR. DAVID B. LOVELL	Worcester, Mass.
DR. JAMES F. McCAW	Watertown, N. Y.
DR. O. A. M. McKIMMIE	Washington, D. C.
DR. HARRIS P. MOSHER	Boston, Mass.

DR. JOHN R. PAGE ..... New York City
DR. CHARLES E. PERKINS ..... New York City
DR. WENDELL C. PHILLIPS ..... New York City
DR. EDWARD M. PLUMMER ..... Boston, Mass.
DR. NORVAL H. PIERCE ..... Chicago, Ill.
DR. GEORGE H. POWERS ..... Boston, Mass.
DR. JOHN B. RAE ..... New York City
DR. B. ALEXANDER RANDALL ..... Philadelphia, Pa.
DR. HENRY O. REIK ..... New York City
DR. W. SCOTT RENNER ..... Buffalo, N. Y.
DR. GEORGE L. RICHARDS ..... Fall River, Mass.
DR. CHARLES W. RICHARDSON ..... Washington, D. C.
DR. W. E. SAUER ..... St. Louis, Mo.
DR. GEORGE E. SHAMBAUGH ..... Chicago, Ill.
DR. BURT R. SHURLY ..... Detroit, Mich.
DR. S. MacCUEN SMITH ..... Philadelphia, Pa.
DR. SELDEN SPENCER ..... St. Louis, Mo.
DR. J. J. THOMSON ..... Mt. Vernon, N. Y.
DR. GEORGE L. TOBEY ..... Boston, Mass.
DR. ERNEST DeWOLF WALES ..... Indianapolis, Ind.
DR. D. HAROLD WALKER ..... Boston, Mass.
DR. JOS. A. WHITE ..... Richmond, Va.
DR. JOHN GORDON WILSON ..... Chicago, Ill.

Guests.

DR. PERRY G. GOLDSMITH ..... Toronto, Canada
MR. WILLIAM GUY RUGGLES ..... New York City

MINUTES.

Monday Morning, May 31st.

Executive Session.

The meeting was opened by Dr. Robert Lewis, the President.

The Minutes of the 52nd Annual Meeting were read and approved.

The Secretary reported that there were at present 111 Active Members, 10 Senior Members and 9 Honorary Members.

During the past year 6 members had died:

Drs: Stephen H. Lutz of Brooklyn, N. Y.
Jos. A. Kenefick of New York City
Alfred F. Koetter of St. Louis, Mo.
Christian R. Holmes of Cincinnati, Ohio
Wm. K. Rogers of Columbus, Ohio
Stephen O. Richey of Washington, D. C.

The Council had held two meetings during the past year. On behalf of the Council the following nominations were presented:

For President—Dr. Wells P. Eagleton of Newark, N. J.

For Vice-President—Dr. Herbert S. Birkett, Montreal, Can.

For Secretary-Treasurer—Dr. Thomas J. Harris, New York City.

Additional Member of the Council—Dr. Eugene A. Crockett, Boston, Mass.

The Secretary presented the resignations of Drs. J. B. Clemens of New York City and John Dunn of Richmond, Va. On motion, duly seconded, these resignations were unanimously accepted.

Article II, Section 2 of the By-laws, referred to the Council at the last Annual Meeting for consideration, was, upon motion, unanimously amended to read as follows:

"The Council shall consist of the President, Vice-President, the Secretary, the retiring President, who

shall be a member for two years after his term of office has expired, two other members, one of whom shall be elected by the society each year; the elected members shall retire in order of their election, one each year."

The following nominations for membership were made:

Dr. Calvin D. Faunce, Boston, Mass. Proposed by Dr. F. J. Jack; seconded by Dr. Eugene Crockett.

Dr. Leon E. White, Boston, Mass. Proposed by Dr. F. L. Jack; seconded by Dr. J. B. Rae.

Dr. Dana W. Drury, Boston, Mass. Proposed by Dr. F. L. Jack; seconded by Dr. J. B. Rae.

Dr. H. P. Cahill, Boston, Mass. Proposed by Dr. F. L. Jack; seconded by Dr. E. A. Crockett.

Dr. I. Friesner, New York City. Proposed by Dr. W. Phillips; seconded by Dr. J. R. Page.

Dr. Edward B. Gleason, Philadelphia. Proposed by Dr. B. A. Randall; seconded by Dr. R. Butler.

Dr. George M. Coates, Philadelphia. Proposed by Dr. B. A. Randall; seconded by Dr. T. J. Harris.

Dr. Jos. C. Beck, Chicago. Proposed by Dr. N. H. Pierce; seconded by Dr. G. E. Shambaugh.

Dr. H. Wilson, Detroit, Mich. Proposed by Dr. E. Amberg; seconded by Dr. B. Shurley.

Dr. J. C. Keeler, Philadelphia. Proposed by Dr. S. McCuen Smith; seconded by Dr. B. A. Randall.

Dr. J. G. Dwyer, New York City. Proposed by Dr. J. B. Rae; seconded by Dr. W. C. Phillips.

The Committee on the Deaf Child, through its Chairman, Dr. Charles W. Richardson, presented the following report:

Report of Committee on the Deaf Child.

At the call of the Chairman, the first meeting of the permanent Committee on the Deaf Child, selected at the last meeting of the Section on Laryngology and Otology of the American Medical Association, was held at the Hotel Chatham in New York, March 4, at ten o'clock. All members of this committee, Dr. Charles W. Richardson of Washington,

Dr. Elmer L. Kenyon of Chicago and Dr. Max A. Goldstein of St. Louis, were present. Representing the American Otological Society in similar committee were: Dr. Charles W. Richardson of Washington, Dr. Thomas J. Harris of New York and Dr. Max A. Goldstein of St. Louis. The committee elected as permanent officers Dr. Charles W. Richardson, Chairman; Dr. Max A. Goldstein, Secretary.

In an informal discussion, the members of the Committee set forth the aims and objects of their work. Following these preliminaries, a fixed program was outlined and a classification of work presented.

It was the consensus of opinion that much effective work could be done in the interest and uplift of the Deaf Child. The captions under which the Committee decided to plan its work are as follows:

(1) Compulsory Notification.
(2) Standardization.
(3) Classification of the Deaf Child.
(4) Day Schools for the Deaf.
(5) Medical Co-operation.

(1) Compulsory Notification.

At the National Convention of the Society of Progressive Oral Advocates (teachers and friends of the deaf) held in St. Louis June 23, 1919, a resolution was introduced by Mr. John Dutton Wright of New York setting forth the necessity of such an act and analyzing its importance. After liberal discussion, this association adopted the Wright resolution.

On motion duly presented and seconded it was unanimously voted that: The necessity of Compulsory Notification by the parents of a deaf child to the Health Officer or Instruction Official of such community is emphasized and, it is further Resolved, that the Wright Resolution be adopted by this Committee in planning its program and, it is further ordered, that a copy of this Resolution be incorporated in the Committee's Report, to wit:

Resolved, That steps be taken to make impaired hearing in children reportable, and to endeavor to have such an act passed by the legislature of each State and by the Nation.

By such legal and protective measures it may be made possible to safeguard the interests of the Deaf Child in every State and to keep in touch with his educational opportunities as readily as with the normal child.

Furthermore, the Secretary of this Committee is instructed to obtain abstracts of the law pertaining to this question as enacted in all states.

To emphasize the importance of this question the Committee presents the following Resolution:—Resolved, that the American Medical Association be requested through its Secretary to furnish abstracts of all legislation in regard to the Deaf Child in all States where such legislation has been enacted and also to furnish information to this Committee of all States in which no such enactments have as yet been made.

(2) Standardization.

The survey and standardization of medical schools throughout the country as instituted and carried out by the Carnegie Foundation during the past ten years has been productive of such excellent results toward developing higher standards, improving equipment, supplying adequate resources and more efficient instruction and instructors that this Committee considers it a matter of greatest importance to urge the endorsement and co-operation of the American medical profession, through all of its organized bodies, institutions and individuals, of the plan now under consideration for a similar survey and ultimate standardization of all Schools for the Deaf.

The American Association to Promote the Teaching of Speech to the Deaf, the Conference of Superintendents of Schools for the Deaf, the Convention of American Instructors of the Deaf and the Society of Progressive Oral Advocates,—all national associations including superintendents, principals, teachers, pupils and friends of the Deaf are actively considering this question of Standardization of Schools for the Deaf.

A joint convention of the three national associations concerned with the teaching of the Deaf will be held at the

Pennsylvania Institution for the Deaf at Mount Airy, June 28—July 3, 1920, and a call has been issued for a Joint Committee Meeting of these national organizations through special committees appointed for the consideration of this great problem.

The Secretary of your committee reports that in a preliminary conference with the Director of the Rockefeller Foundation and the Director of the Carnegie Foundation, he has received the encouraging assurance of a careful consideration of the outcome of this joint conference. It is hoped that a definite recommendation will follow the Mount Airy meeting and that this report may be submitted to the Carnegie Foundation and the Rockefeller Foundation for further consideration.

Your Committee heartily endorses this plan of survey and standardization of Schools for the Deaf and desires the ratification of the Section on Laryngology and Otology and the official approval of the House of Delegates of the American Medical Association at its meeting in New Orleans in April 1920. Dr. Max A. Goldstein has been appointed the representative of this Committee to the Mount Airy meeting.

(3) Classification of the Deaf Child.

We have classified the Deaf Child in three groups:

(a) Congenital Deafness.

(b) Acquired Deafness (before Two Years of Age.)

(c) Acquired Deafness (after Two Years of Age.)

(d) Defective Hearing.

(a) Congenital Deafness.

Congenital Deafness is that type of deafness due to a lesion, absence of rudimentary development of an integral part of the sound-conducting or sound-perception apparatus, which is permanent. As the congenitally deaf child has not the perception of sound the spoken voice is undeveloped.

The management of the congenitally deaf child presents a different and much more difficult problem than the acquired deaf child. Such children can be better managed and taught in institutional environment.

(b) Acquired Deafness (Before Two Years of Age).

Profound deafness, acquired by a child of less than two years of age, places such child in a classification with the congenitally deaf child; for, if deafness is acquired at an age before a child has learned speech in so early an age that such rudiments of speech are promptly forgotten, he is placed in the same position for his educational management and his general environment with that of the congenitally deaf child.

(c). Acquired Deafness (After Two Years of Age).

A child who becomes seriously or totally deaf after he has acquired speech still retains a great asset as an educational factor. Speech in the normal child is an imitation of the vocal sounds he hears. Language becomes an indelible memory and even in the presence of serious deafness the natural production of speech cannot be altogether eliminated in his training. The educational conditions, therefore, of a child who has acquired speech must be carefully considered and all special opportunities afforded for the conservation of this asset.

(d) Defective Hearing.

This term covers by far the largest number of deaf children. In this class would be placed all deaf children other than those belonging to classes a, b and c. The degree of defective hearing varies within the widest limits. The prognosis is naturally by far the best. For the children of this class, the recommendations in regard to medical co-operation apply with double force. The vast majority of these children, handicapped by reason of varying degrees of deafness, often unrecognized, are capable of being relieved under proper treatment.

(4) Day Schools for the Deaf.

In recent years Day Schools for the Deaf have been organized in conjunction with the public school systems of our metropolitan cities and opportunities are thus afforded all children living in such communities to attend such day schools near their homes.

Enactments have been made in a number of states to authorize local Superintendents of Instruction of cities of form-

idable populations to create classes in conjunction with their public school systems and provide a teacher for such classes for every eight to ten deaf children of school age found in such community.

In the consideration of progressive educational work your Committee desires to be placed on record with its endorsement of oral education for all deaf children as follows:—

Resolved, That we recommend exclusively oral instruction of deaf children and that the oral teaching of the congenitally deaf child and the acquired deaf child be made a part of a department of the public school system in all larger cities.

(5) Medical Co-operation.

Medical co-operation is classified as follows:

(a) Co-operation with school authorities.
(b) Co-operation with medical examiners.
(c) Measures for the prevention of deafness.
(d) Medical under-graduate education.

(a) Co-operation with school authorities.

In its co-operation with school authorities your Committee desires to submit the following:—

Resolved, That medical men in all communities should uphold this Committee of the Deaf Child in connection with all efforts made toward improving the instruction of the deaf child, and that all medical men use their personal influence with School Boards and Superintendents to the fulfillment of the various suggestions of the Committee.

It is the intention of the Committee to work out a plan of co-operation with local medical organizations throughout the country and offer local otologists an opportunity for such co-operation under this general guidance.

(b) Co-operation with medical examiners.

Medical examiners in public schools should refer all cases of deaf children to local otologists for definite classification as to the degree and character of deafness.

To facilitate and standardize this work your Committee submits the following record sheet of examination and func-

tional tests and recommends the adoption of this uniform record sheet as a standard.

(c) Measures for the prevention of deafness.

We urge the continuation of medical examination and the application of all methods or treatments in either acute or chronic types of deafness which may tend to modify or check the impairment of hearing.

(d) Medical under-graduate education.

Some years ago a special committee of the American Laryngological, Rhinological and Otological Society and of the American Otological Society was appointed to develop ways and means of presenting to the graduating class of every medical school one or two lectures having for their purpose the instruction of the senior medical student in matters pertaining to the deaf child, viz:—the causation of deafness, a classification of the types of deafness, the proper instruction of the parents of deaf children as to their care before school age, the locality of all State and local schools, public and private schools concerned with the education of the deaf child, the character of instruction given at such schools and all other data that may be of value to the young physician in shaping his opinion and assuming his responsibilities in connection with this vital problem.

RECORD SHEET

Case No._____Name_____Diagnosis_____

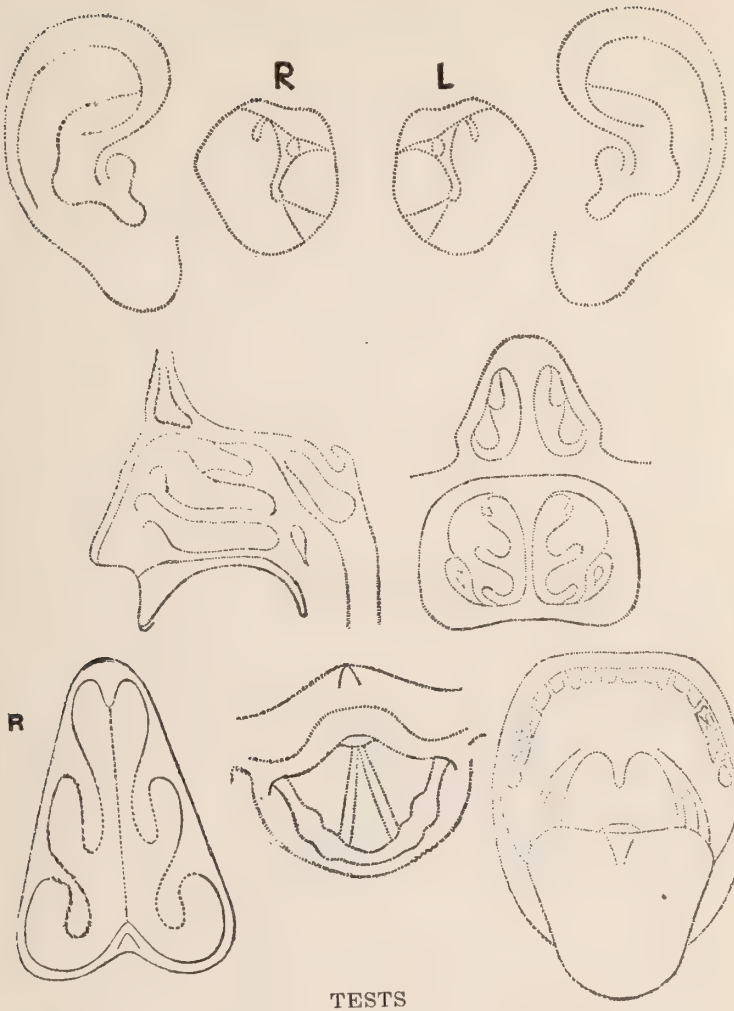
Date__ _____School or Address_____Age____ _____

Previous History—

Deafness—Congenial or Acquired
At what age was hearing lost?
What cause?
Totally or partially deaf?

Present Condition—

Is speech normal?
Is eye-sight normal?
What mental status?
Binet-Simon Test.
Wassermann Test.



TESTS

R		L	R		L
	Voice			**Symptoms**	
	Words			Deafness	
	Sentence			Discharge	
	Conversat.			Pain	
	Whisper			Tinnitus	
	Watch			Vertigo	
	Ingersoll			Paracusis	
	40 inch			Membr. Tymp.	
	Static Sense			Eust. Tube	
	Rotation			Mastoid	
	Caloric				

In conclusion, your Committee requests an enlargement of the scope of work assigned to it to include the general subject of Corrective Speech so that it may prepare plans along similar lines toward the amelioration of speech defects in its various forms and degrees as affecting the American child.

Respectfully submitted,

Charles W. Richardson,
Max A. Goldstein,
Thomas J. Harris.

Discussion.

Dr. Charles W. Richardson said that it was astonishing how little the average man knew about teaching of the deaf; he did not know any place where he could get a teacher for deaf children. People had to be told of such persons in their own town. This did not apply to third and fourth rate otologists, but to first rate men who ought to know better.

The President announced that this very exhaustive report of the Committee on Deaf Children was open for discussion.

Dr. F. L. Jack said that this matter was very timely. He was one of the Advisory Committee in Boston, for the education of the deaf child. This Committee had invited Dr. Goldstein to speak on the teaching of the deaf, to the public school teachers. Dr. Goldstein's report was based on his personal experience. If one had to interest the medical profession and teachers, there was no better way than by personal touch. It was surprising to see what a new incentive this address was to go ahead with plans for getting new teachers. Dr. Goldstein could not be expected to go around the country stumping. Otologists should take a personal interest in the matter.

Dr. Thomas Hubbard said that he would like to call attention to the fact that the recommendation of the Committee stated "larger" cities, the country child was apt to be sequestered. In Ohio, where the parents of six deaf children

demand a teacher, the authorities are compelled to provide one for such a community. He would like to offer an amendment to this effect.

Dr. Emil Amberg said that the deaf child should come in contact as much as possible with the hearing child. They should not be segregated too much. Deaf children were apt to seek too much seclusion. The Committee might be interested to know that a photo-film had been brought out, dealing with the education of the deaf child. The children are called for by the police and taken to the school, and brought home safely. It would be a good thing for the committee to have the film exhibited.

Dr. C. W. Richardson said that Dr. Pierce had called his attention to it. The report blanks for the children showed date, age, address, cause, mental status, voice, words, sentence, whisper, watch, Ingersoll, and symptoms. The chart should come into the hands of school teachers and otologists everywhere. It was particularly desired to interest school boards in the question of day schools for the deaf. He had been to several school boards, and there was instant and unanimous support of the idea. It was such an appealing call upon the educational authorities that there was no difficulty whatever in getting them interested. In regard to Dr. Amberg's remark,—the young, congenitally deaf child could not, with advantage, be brought up in contact with average environment, but the cases of acquired deafness are brought in contact with hearing children through school work. If the children had ever acquired speech, they should be brought in contact with the hearing child. In regard to smaller communities,—there would be no difficulty, all the Committee had to do was to start the movement, it was one that appealed to everybody.

Dr. George L. Richards said that there was the group school for the defective child; one could have a similar plan for the deaf child.

Dr. C. W. Richardson asked that the Committee be made permanent.

It was moved, duly seconded, and carried that this Committee be continued, and that the report of the Committee be received and placed on file.

Dr. C. W. Richardson, as delegate from the Society to the American Congress of Physicians and Surgeons, reported that there was a deficit in the Treasury of the Congress. The President said that this matter had come before the Council, which had decided that the share of the Society's deficit should be paid out of the Treasury.

Dr. Wendell C. Phillips spoke of the work of the National League for the Hard of Hearing and moved that the Society's relationship to this organization be referred to the Council for its consideration. On motion, duly seconded, the recommendation was approved.

Report of the Treasurer.

The Treasurer presented his annual report, as follows:

Expenditures for 1919-1920.

1919			
June		Dr. Loy McAfee	$ 88.46
June	26	L. H. Bigelow Co.	57.45
July	2	Fred L. Jack	9.68
July	10	Postage	4.00
July	31	Geo. C. Feltner	3.25
July	31	L. H. Bigelow Co.	21.25
Aug.	30	L. H. Bigelow Co.	7.00
Oct.	28	Office Supply, Sec.	7.00
Nov.	3	Postage	3.00
Dec.	3	Postage	2.00
Dec.	10	Mercury Publishing Co.	564.85
Dec.	11	Lea and Febiger	6.10
Nov.	29	L. H. Bigelow Co.	18.12
1920			
Jan.	31	L. H. Bigelow Co.	8.00
Feb.	2	Postage	2.00
Mar.	3	Postage	2.00
Apr.	30	Postage	1.00
May	13	T. J. Harris, office expenditure	7.68

	Bank exchange	.81
		$813.65
1919		
June 26	Balance brought forward	$271.97
	Receipts from assessments	575.02
		$846.99
	Expenditures as above	813.65
	Balance on hand May 29, 1920.....	$33.34

The report was ordered received and placed on file.

The President appointed Drs. F. P. Emerson and B. R. Shurly as auditing committee.

The Necrologist, Dr. B. A. Randall reported the deaths of Dr. Christian R. Holmes, Dr. Wm. K. Rogers, Dr. Stephen H. Lutz, Dr. Jos. A. Kenefick, Dr. Alfred F. Koetter, Dr. Stephen O. Richey, and Dr. Samuel D. Risley (a former member).

Dr. C. W. Richardson spoke informally of the death of Dr. Stephen O. Richey.

Report of Necrologist.

CHRISTIAN RASMUS HOLMES.

It is not necessary to tell the Members of the American Otological Society how great has been our loss in the death of Christian R. Holmes, so recently our president many may know of him as a charming host and most capable colleague rather than as the many-sided, wonder-working citizen who has been lost to Cincinnati. Dr. Holmes was born in Denmark in 1857 and coming as a young man to this country, was a draughtsman in the Locomotive Works at Vincennes. Overtaxing his eyes, he consulted Dr. Williams of Cincinnati and imbibed from him and his partners, S. O. Ayres and Robert Sattler, the enthusiasm for medical study which led him to work his way through the Miami Medical College in 1886, his skill in drawing serving his colleagues and himself in many medical publications. Always original, zealous and indefatiga-

ble, he was principally intrusted with preparing the plans for the Cincinnati General Hospital, which stands a splendid monument to his years of close study at home and abroad of all that is best in hospital construction.

His other greatest achievement has been the consolidation of the Medical Colleges into the University of Cincinnati Medical College, of which he became dean and proposed to devote himself to developing it into one of the great medical schools of the world. But the great war called his activities into its service and as Major, M. R. C. and Chief of the Surgery of the Head he was largely instrumental through his knowledge of hospital matters in making Camp Chillicothe the efficient center medically which it became. Early entrusting his two older sons to the army, he had the great satisfactin of seeing the elder son one of the first to receive the Croix de Guerre and the Distinguished Service Cross. Present at our Meeting in Atlantic City last May, it was with rather a wan smile that he greeted his friends, for rapidly advancing disease had laid a heavy hand upon him and in the fall we learned with dismay that Sarcomatosis was hurrying him toward the end which he bravely met Dec. 27th. His writings were many and valuable, for he had unusual grasp upon all aspects of the Surgery of the Head and was almost the only man belonging to all three of the American Ophthalmological and American Otological and the American Laryngological Societies. He had made great progress on a treatise on "The Relations of Disease of the Nose and Its Accessory Cavities to Affections of the Eye and Orbit," which no man was better fitted than he to illuminate by his corelating knowledge and his surgical and artistic appreciation of the portrayal of the anatomy of these parts.

He left money for the founding of a medical journal that should speak for the high standards to which he was devoted; and medical memorials of him in Cincinnati will be more personal and outstanding than the great Hospital and the University Medical College with which he will ever be gratefully identified.

SAMUEL DOTY RISLEY.

Dr. Risley, no longer on our membership list and probably unknown to many of the younger members, was better known as an ophthalmic surgeon; but he was a regular attendant at our Meetings in those days when such a group of us used to gather on the New London steamer and held our informal discussions late into the night as we journeyed toward the old Pequot House. Too busy in public and private practice to write much except in eye-matters, in which he was teaching, he was yet the one whom I hail with Politzer as having most helped me in Otology—distinct credit as I must give to Strawbridge for his admirable elementary instruction of us undergraduates. Risley was one of the pioneers in the practical recognition of the close relation of Rhinology to Ophthalmology and did no small work in the corelation of these specialties—too often considered as unassociated. He founded in the early seventies the Eye and Ear Service of the Episcopal Hospital in Philadelphia and built it up to great value before I succeeded him there in 1882; and more items of my practice and teaching than I myself appreciate were learned of him. Having in his ophthalmic work acquired that delicacy of touch which Wilde claimed as one of the advantages of combining these specialties, he yet avoided the tendency to hair-splitting minuteness which has been laid to its charge.

Dr. Risley was born in Cincinnati and received there his earlier education, moving later to Davenport, Iowa. His college course at the University of Iowa was interrupted by the Civil War, and enlisting as a private he served three years, promoted to corporal and sergeant. Completing his college work at Iowa in '68, he studied Medicine in Philadelphia and graduated from Pennsylvania in '70, soon becoming an assistant at Wills Eye Hospital and at the University and Chief of the Eye Clinic when, on moving to West Philadelphia, the Eye and Ear Clinic were separated. Later a full Surgeon to the Wills and Professor of Opthalmology at the Polyclinic, he ceased his teaching at the University; but in the busiest years

of his eye work he always held numbers of well-satisfied ear-patients. He was for many years a member of this Society; but his duties as President of the American Ophthalmological, of the Academy of Medicine and other societies led him to concentrate his work and to resign from our membership—the separation of the time and place of meeting of the Otological from that of the Ophthalmological having forced many valuable members to make a like choice as to which Society they would attend. His contributions were to the discussions rather than to the list of papers; but his essential "saneness" made them of real value. Associated with him for three years in private practice, as well as many more in hospital work, I had the opportunity of a valet to recognize him as "no hero"; but the longer and closer my acquaintance, the deeper has been my admiration and love for him. He died, partly of overwork on April 1st of this year. Shortly before, some colleagues learned that March 17th was the fiftieth anniversary of his graduation in medicine, and at a day's notice forty of his pupils gathered at a surprise luncheon in his honor. He was deeply moved, so much that his reply to the congratulations of the chairman fell short of the usual felicitous diction which made him such an admirable toast-master at our Ophthalmological-Otological banquet here in Boston a dozen years ago. There was a somber note as of a course already run and of imminent parting in his remarks which led one who was present to rise to change the key: "Dr. Risley has always taught us optimism. The small boy in his definitions wrote, 'An optimist is a man who looks into our eyes; a pessimist one who looks after our feet.' Risley has always looked every man straight in the eye, and never looked at our feet—the feet of clay so many of us stand upon. And that is the reason we admire and love him."

WILLIAM KING ROGERS.

In William K. Rogers this Society has lost a most valuable member and the University of Columbus a well-equipped

teacher of our specialty. Graduating from the University of New York in 1889, he had impressed himself strongly upon the profession at Columbus, Ohio, by his sterling worth rather than by his activities as a writer. He succumbed to septicemia on February 27th in his 56th year at the hospital which he had so well served in his skilful care of others.

It was moved, seconded, and carried that the assessment for the coming year be $15.00.

EXECUTIVE SESSION.

It was moved, seconded and carried that the report of the council, acting as nominating committee, be approved..

It was moved, seconded and carried that the secretary be authorized to cast one ballot for the names proposed, whereupon they were declared duly elected.

The auditing committee reported, through its chairman, Dr. Emerson, that it had examined the books of the treasurer, and found them correct.

Upon recommendation of the council the following members were excused from attendance: Drs. Joseph A. Andrews, Frank J. Blodgett, Charles N. Cox, J. W. Downey, Jr., J. M. Ingersoll, Franklin M. Stephens, Joseph A. Stucky.

Dr. Henry O. Reik, secretary of the Ninth International Otological Congress presented a report. He said that the next congress was to have been in Germany, but letters had been sent to France, Belgium, England and Italy discussing the matter. One plan proposed had been to have an International Congress of Medicine, and the officers of the American Otological and the Triological had been invited by the president, Dr. Simpson of Pittsburgh, to participate. Dr. Dench proposed that the original plan should be followed until the members had had a chance to discuss and to vote as to what country they preferred. Replies had been received from 37 members of the International Congress; twenty had voted for France. No members had voted for their

own country; French delegates had voted for Belgium. A letter had been addressed to Dr. Luc, the French delegate, but a communication had been received stating that he was very ill and could not attend to the matter now. Other letters sent to French delegates asking what city in France should be chosen, were too recent to have received reply.

On motion, duly seconded, and carried, it was recommended that the report of Dr. Reik be accepted and placed on file.

The matter of the Washington meeting of 1922 was considered.

Dr. C. W. Richardson and Dr. O. A. M. McKimmie were elected as delegates to represent the Society at the congress of Physicians and Surgeons.

There being no further business, the executive session adjourned.

Monday Morning, May 31st.

Scientific Session.

Papers were read by Drs. L. W. Dean, E. H. Nichols, Philip Hammond.

Monday Afternoon, May 31st.

Scientific Session.

Papers were read by Drs. Henry O. Reik, Wells P. Eagleton, John R. Page, Charles E. Perkins, Norval H. Pierce, B. Alexander Randall.

Tuesday Morning, June 1st.

Scientific Session.

Papers were read by Drs. John F. Barnhill, George E. Shambaugh, Emil Amberg.

Tuesday Afternoon, June 1st.

Scientific Session.

Papers were read by Drs. George A. Leland, Isaac H. Jones, and (by invitation) Mr. Wm. Guy Ruggles.

The Society then went into Executive Session.

EXECUTIVE SESSION, JUNE 1st.

The Secretary said that a motion to pay dues before the receipt of the transactions was in order, as the treasury was

empty, and it was not advisable to wait until the transactions were published.

Dr. Richardson moved, Dr. Goldstein seconded, that the payment of annual dues be immediate, and not postponed till after receipt of the transactions.

Dr. Lewis said that a very successful meeting had been held and he felt that they should place credit, where it was due, to the work and energy of the Secretary. He also wished to thank the committee on arrangements for their hospitality. He now wished to introduce the incoming President, Dr. Wells P. Eagleton.

Dr. Richardson said that they had had the most successful meeting of recent years. The papers had been good and the discussions had been fair. The presiding officers had promoted a very successful meeting. He wished to move a vote of thanks to the presiding officers and Secretary for their very efficient conduct of the meeting. Dr. Randall seconded this, which was unanimously carried.

Dr. Lewis said that the work of the association was progressing by the new method of administration, that was, with a continuous group of men in the council, from 2 to 4 years. They had the interest of the society at heart and the meetings were not cut and dried. An improvement and uplift in the discussion had been noted.

Dr. Goldsmith of Toronto said he wished to thank the society for the honor done him in permitting him to address the meeting on behalf of the medical profession of Canada.

There being no further business to come before the society the meeting adjourned.

RESULTS OBTAINED FROM ONE YEAR'S USE OF THE AUDIOMETER IN THE OTOLOGICAL CLINIC.

By L. W. DEAN, M. D. and C. C. BUNCH, M. A., Iowa City, Iowa.

In order to justify the use of new diagnostic methods, it is necessary to demonstrate that they will either present evidence hitherto unobtainable or that they will present the evidence obtained by former procedure in a more definite and satisfactory manner. The use of the Pitch Range Audiometer in the otological clinic has been justified from both viewpoints. The results of tests are definite and easy of interpretation. They are capable of immediate verification. The presence of unsuspected gaps and islands in the range tested is easily ascertained.

In the otological clinic during the past year the audiometer has been used in testing all of the more difficult otological cases and a series of cases embracing the more common ear diseases. It has not been used in all the cases because it was desirable to check the findings secured with the audiometer in each case. In each case the tuning fork tests were made by two different individuals and the results secured compared with the findings of the audiometer. This required so much time that it was not possible to test all cases. In all, two hundred cases were tested and results checked. Some cases were tested eight or ten times. In a number of cases the results of one of the two examinations with the tuning fork did not agree with the findings of the audiometer. In every case where there was a difference careful examination was made by Dr. Dean and the audiometer findings were always found to be correct while the tuning fork tests were at fault.

One examination with certain forks from the Bezold set was made by a clinical assistant; the examination with the audiometer and the second tuning fork test was made by Mr. Bunch. The audiometer used had a range from thirty to

seven thousand seventy double vibrations. Mr. Bunch is now using in the psychological laboratory a machine with a range of from twenty-five to fourteen thousand double vibrations. A similar machine is being prepared for the clinic.

The time necessary for the complete examination with the audiometer averages fifteen minutes. This includes the time required for such oral instructions as are necessary and for writing up the record. Any intelligent individual can make the tests. This very thorough testing of the audiometer has convinced us of its accuracy and reliability. From now on the examination with the audiometer will take the place of certain of the tuning fork tests in our clinic. The examinations will be made by the assistants and internes.

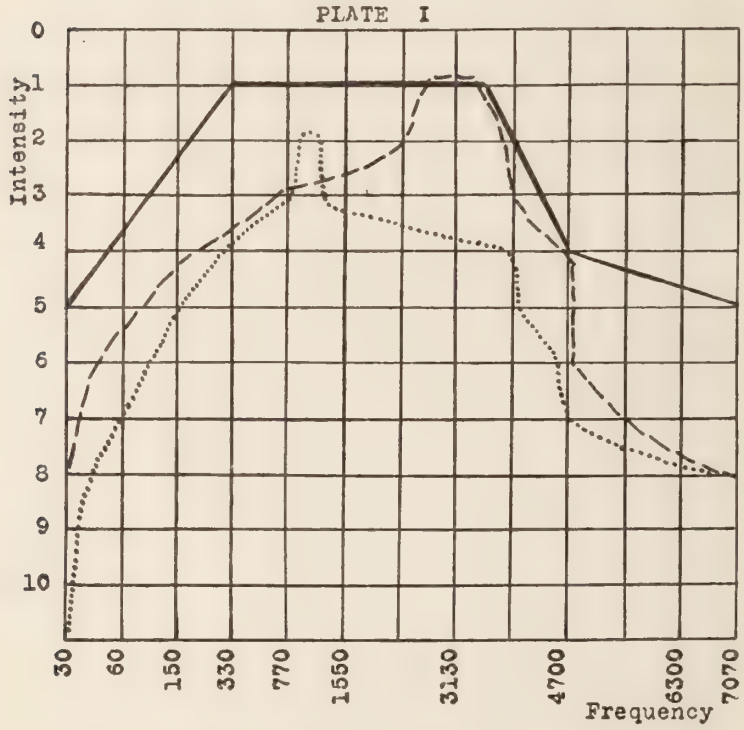
The only instruments so far made are those which have been prepared in the psychological laboratory. We are not fortunate enough to have an instrument in rooms for private cases. We have become so dependent upon this instrument that with many of the rather difficult cases in private practice we have felt that we were not prepared to render definite opinion until the tonal range had been tested with the audiometer. This has been of particular value in diagnosing otoselerosis in a patient that has had previously a suppurative otitis resulting in marked cicatricial changes in the tympanum.

The charts which we wish to present show first the accuracy and reliability of the records in comparison with other clinical tests.

The solid line at the top of the page indicates the average tentative curve for ears known to be normal. The figures at the bottom indicate the range of frequencies which are produced. The numbers at the left indicate the intensities, faint tones being produced on step 1 and louder ones toward the bottom of the chart. For convenience we have indicated the curve for the right ear by a black line and that for the left by a red one.

In all of these charts, the record of the audiometer test is more comprehensive. The questionable diminution for high tones is amply verified. The factors of error in the tuning

fork and the voice tests are such that even the examiner often questions his findings. Often patients who claim better hearing in one ear than the other have had it demonstrated by interchange of the telephone that certain tones may be heard better in the so-called poorer ear.



The first aim of our research was to determine the possibility of indicating a normal curve for various ear lesions, but the results varied so widely with the progress of the infection that this was found impossible. The distinguishing characteristic was shown to be the shape of the curve rather than its height on the chart. For example, it is easy to understand that results from an old acute condition would be much more marked than in a similar one of recent occur-

rence, but the same general trend would be observed. Already certain curves are suggestive of particular diseases.

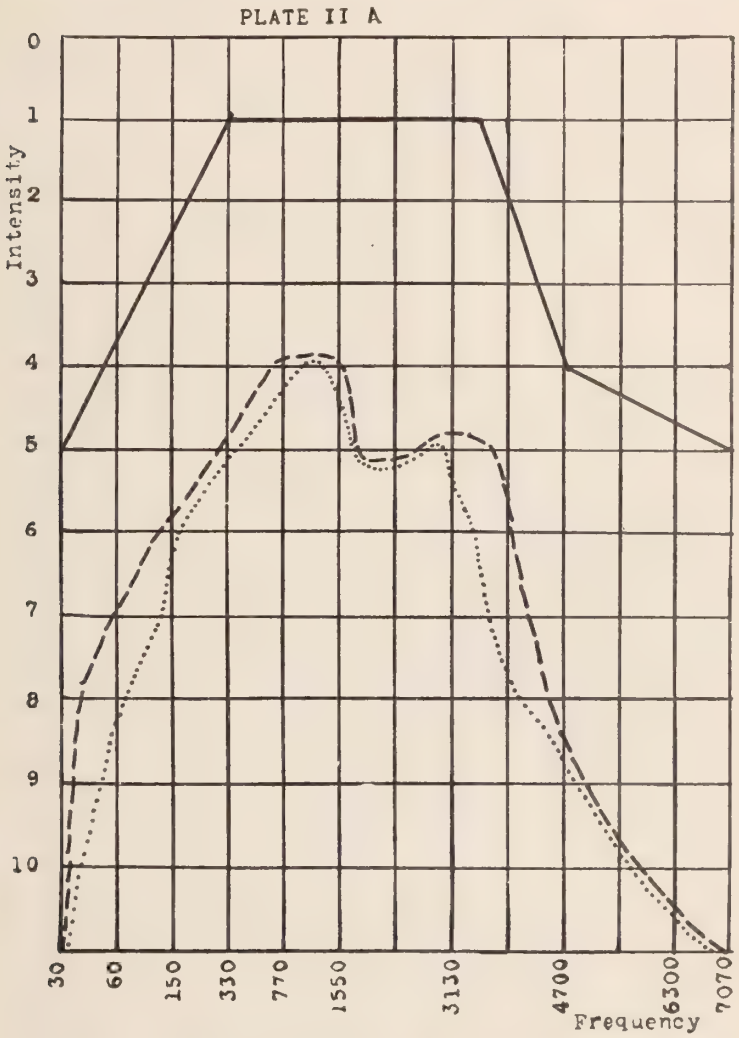


Plate I. Otitis Media Sicca left. Chart shows audition for low notes much diminished; for high just slightly diminished.

	50 d. v.	128	256	512	1024	2048	4096
Left	0	2	6	12	24	36	60
	4	4	8	12	24	36	60

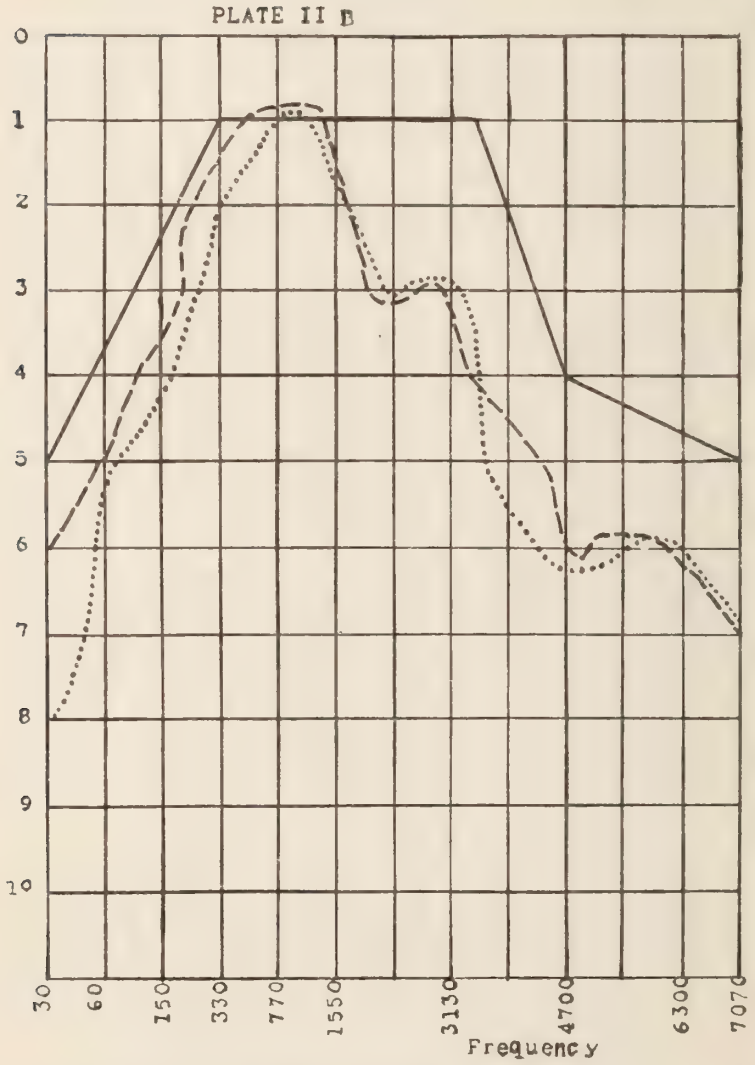
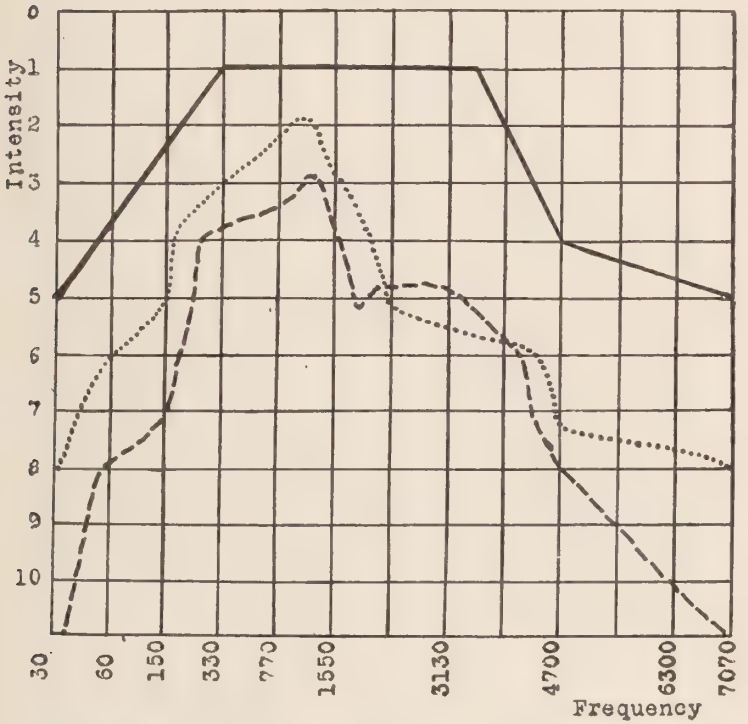


Plate II. Tubal Catarrh. Plate II a shows the curve before inflation, and Plate II b the curve after.

Hearing before inflation. Right whisper two feet, spoken voice five feet. Left whisper one foot, spoken voice five feet.

	50 d. v.	128	256	512	1024	2048	4096
Right	1	3	10	15	20	25	30
	2	6	12	18	24	36	60
Left	1	3	10	15	20	25	30
	2	6	12	18	24	36	60

Plate III



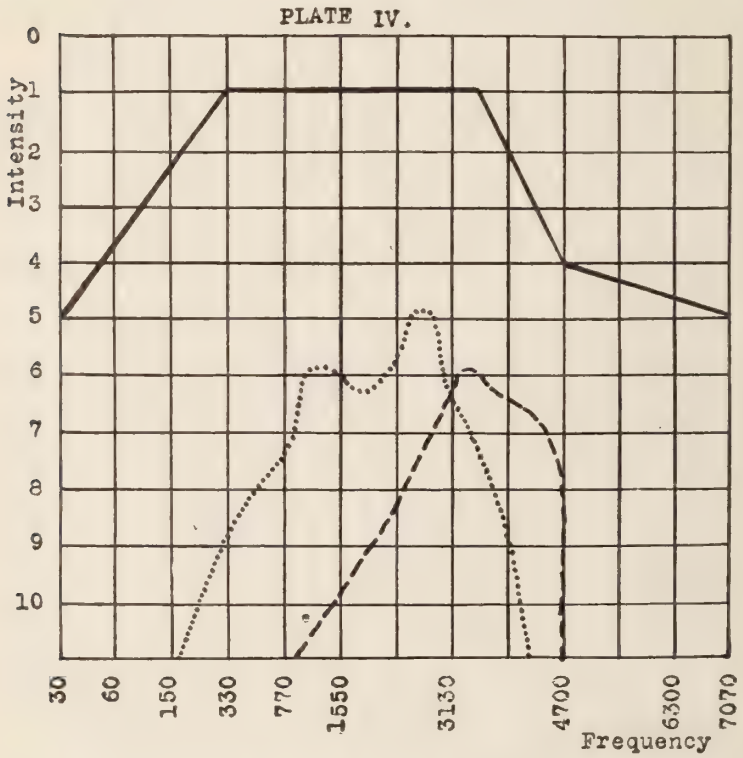
Hearing after inflation. Right whisper thirty feet, spoken voice sixty feet. Left whisper thirty feet, spoken voice sixty feet.

	50 d. v.	128	256	512	1024	2048	4096
Right	2	6	12	18	24	36	60
	2	6	12	18	24	36	60
Left	2	6	12	18	24	36	60
	2	6	12	18	24	36	60

Note the increase in audition for all notes resulting from the ventilation of the tympanum.

Plate III. Bilateral recurring otitis media suppurativa.

Hearing. Right whisper four feet, spoken voice twenty feet. Left whisper four feet, spoken voice thirty feet.



In the right ear the curve shows a marked decrease in the audition for high and low notes. In the left ear the decrease is not so marked.

Plate IV. Bilateral Otitis Media Suppurativa Chronica with Involvement of Inner Ear.

Note the marked decrease in high as well as low notes.

Hearing: Right:—Whisper six inches: spoken voice eight feet. Left—Whisper six feet: spoken voice eight feet.

Each ear Rinné negative: bone conduction decreased: right six seconds, left four seconds. The Galton whistle, Koenig cylinders and monochord indicate a lowering of the upper tone limit. The tuning forks show an elevation of the lower. Vestibular reactions were normal.

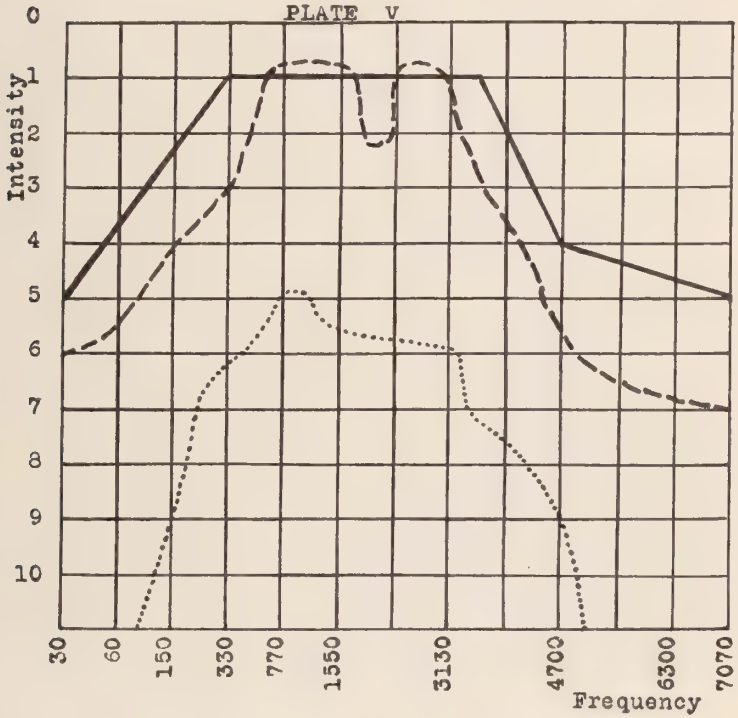
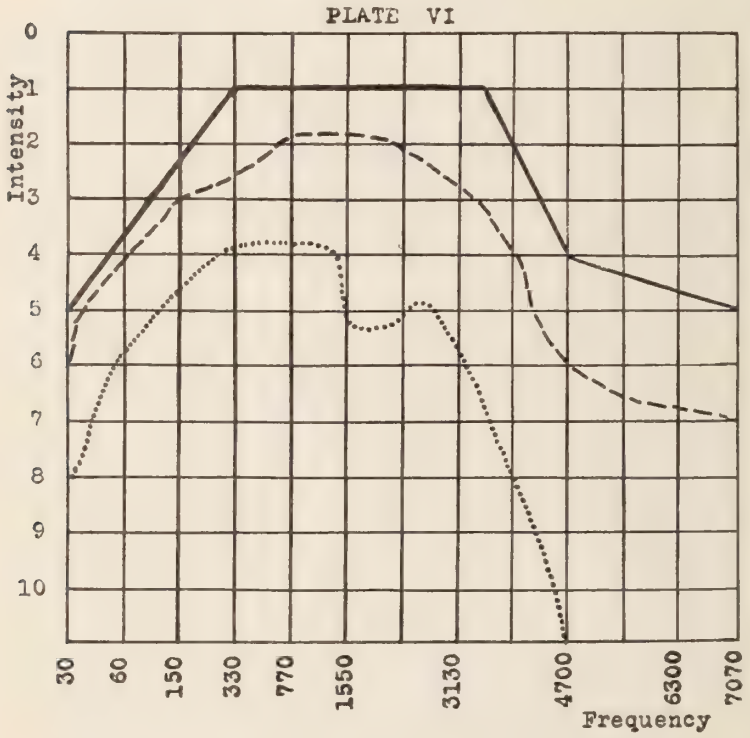


Plate V. Right Otitis Media Suppurativa Chronica. Left Otitis Media Suppurativa Residua with Inner Ear Lesion.

Hearing: Right—Whisper fifteen feet: spoken voice forty-five feet. Left:—Whisper four feet: spoken voice twelve feet.

The curve for the right ear shows slight diminished audition for both high and low notes. The curve for the left marked diminution for high and low notes. Bone conduction right is normal; left diminished one second.

With lesions of the conductive apparatus of the ear the audiometer curve has shown constantly some diminution in audition for high notes. Sometimes the diminution is due to a pure conductive lesion. It is so marked that an inner ear complication is suggested. To show the influence of a pure



conductive lesion on the curve two individuals with apparently normal ears were tested before and after packing the external auditory canal with boric acid powder.

Plate VI. Before Packing the External Auditory Canal with Boric Acid Powder..... After Packing.....

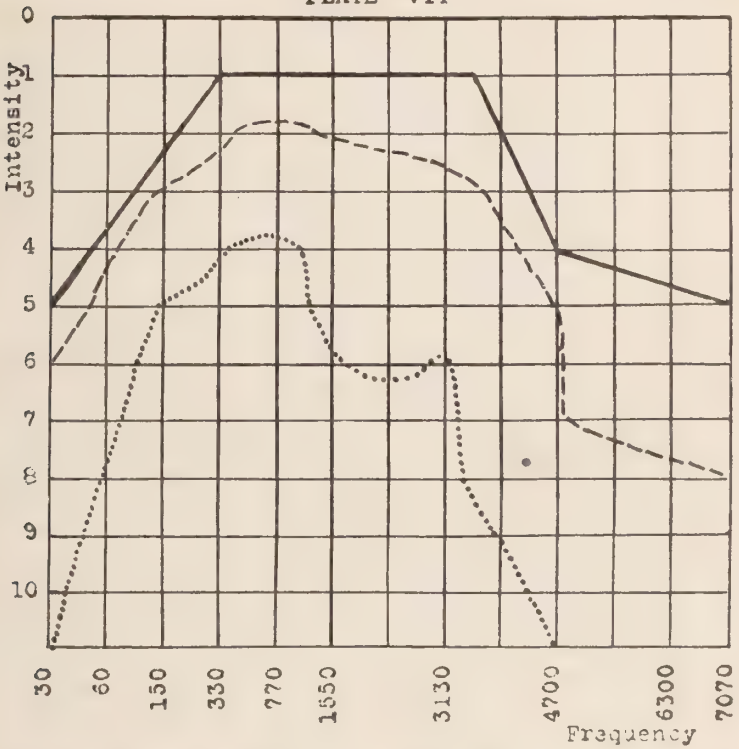
Plate VII. Same as Plate VI.

Note the curves after packing show a distinct diminution in audition for high notes as well as the low.

These two curves show that the audiometer, like the tuning forks, is only an aid in diagnosis of aural lesions. A proper diagnosis can only be made by considering also the results of the other usual diagnostic tests.

Plates VIII and IX. These plates show the curves before and after the removal of a piece of cotton deep in the left

PLATE VII



external auditory canal. This case was a soldier just returned from France. The only complaint was tinnitus aurium.

Hearing: Left—Whisper fifteen feet: spoken voice forty-five feet.

The cotton was lost in the ear evidently several months before when in France. With the hearing practically normal,

the foreign body still produced a slight diminution in the power of hearing high notes.

Plate X. Otosclerosis.

The left curve shows the tone gap which we have found so frequently in this disease.

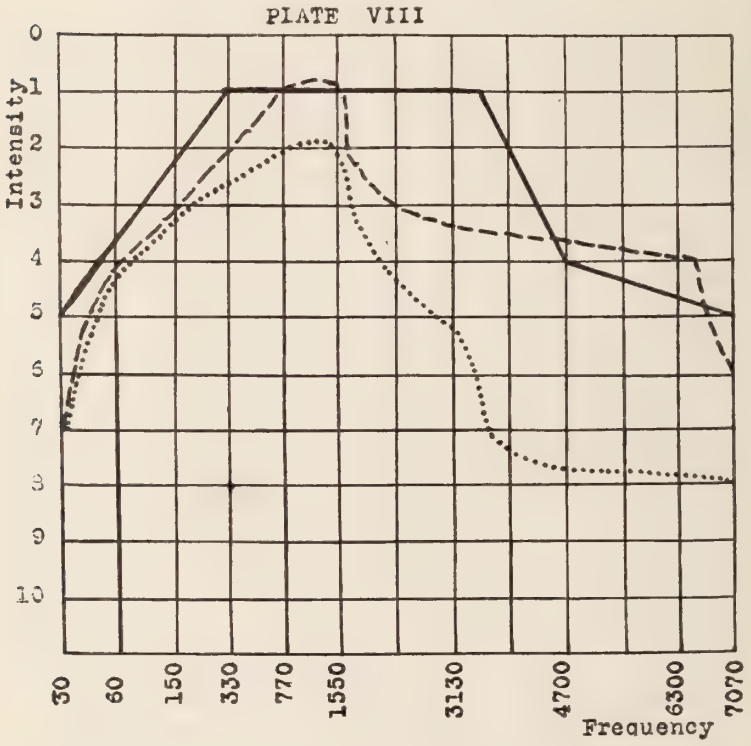


Plate XI. Otosclerosis.

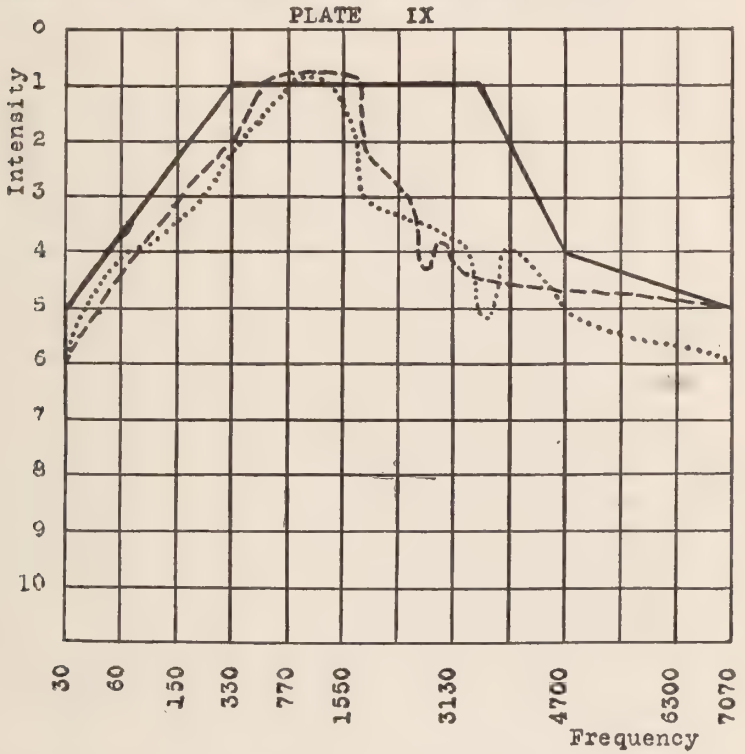
This patient, age twenty-five, complained mostly of tinnitus. She had but little difficulty with the hearing. Examination showed practically normal hearing. The curve shows in the left the marked diminution of audition for low notes.

Plate XII. Bilateral Otitis Media Suppurativa Residua Slight with Neuro Labyrinthitis Syphilitica.

There is a distinct tone gap in the left ear. 2048 fork heard in the left only at great intensity; somewhat better in the right. 4096 fork heard very poorly in each.

Plate XIII. Neuritis Acustica Syphilitica.

Hearing: Right—Whisper fifteen feet: spoken forty-five feet. Left—Whisper fifteen feet: spoken forty-five feet.



Patient gave no history of ear trouble. The ears were examined because of the presence of active syphilis. The high notes are distinctly diminished. The area corresponding to the human voice (about one thousand d. v.) was almost normal. The upper tone limit was but slightly diminished.

Mr. Bunch in his work with students in the School of Music, and with students in United States Radio School has discovered a number of cases of unsuspected acoustic neuritis.

Plate XIV. Bilateral Neuritis Acoustica Secondary to Brain Tumor: Probable Brain-stem Lesion.

Hearing: Right—Whisper fifteen feet: spoken voice forty-five feet. Left—Whisper twelve feet: spoken voice forty feet.

Both high and low notes are cut down in the left ear. Vestibular reactions are almost lost.

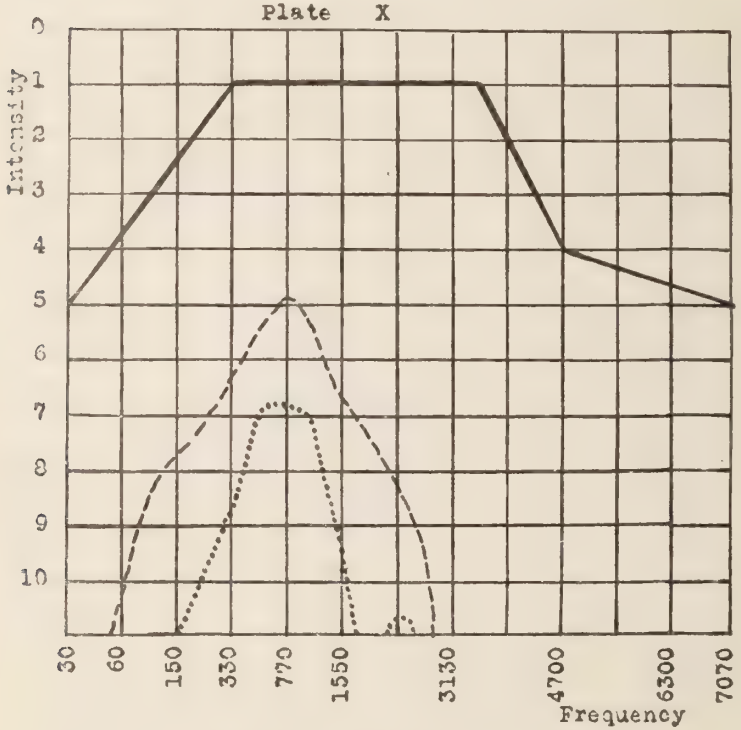
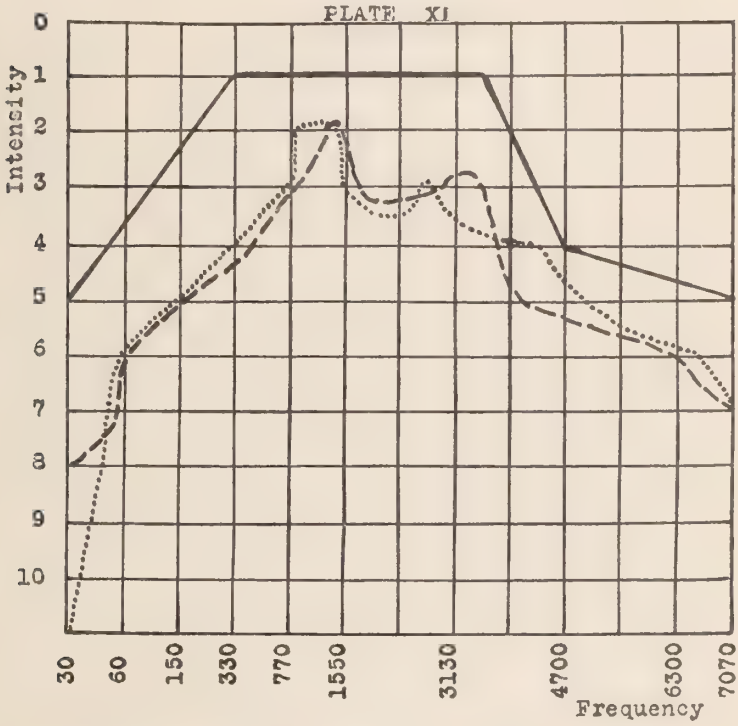


Plate XV. Bilateral Neuritis Acoustica Secondary to Syphilis of the Brain with Hemiplegia left.

Hearing: Right—Whisper twelve feet; spoken voice forty-five feet. Left—Whisper not heard: spoken voice not heard.

Shows a curve for the right ear with audition for both high and low notes cut down. In this case the vestibular reactions were but slightly subnormal.

Plates XVI., XVII. These plates show the curve of a case of hysterical deafness, left ear, preceding and following an electrical treatment with suggestion. Before the treatment the hearing left was very loud voice in two feet. The curve shows audition for all notes cut down; the high and low notes are particularly affected. The curve is somewhat similar to the gun-barrel perimetric fields in hysteria.



After treatment the hearing left was whisper fifteen feet; spoken voice forty-five feet.

The curves indicate increased hearing for all notes in the range from thirty to forty-seven hundred. Beyond forty-seven hundred the hearing is still affected.

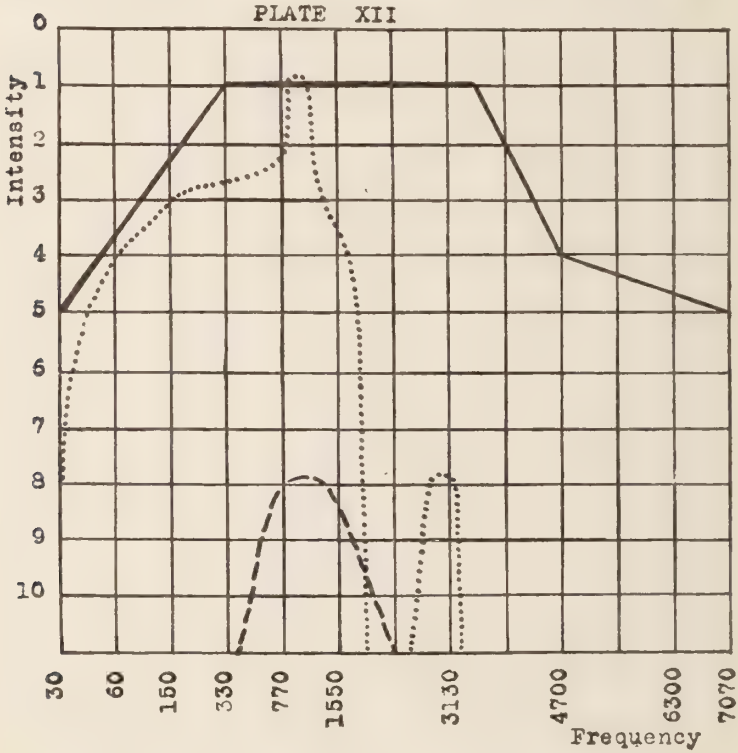
An attempt was made to get a fatigue chart of this patient but it was not successful. In some cases of war neurosis the

repeated examination has shown diminished audition with each consecutive test.

Plate XVIII. Fracture of the Skull.

April, 1918 fracture of skull. Unconscious for two weeks.

April 22, 1919, one year after said hearing right ear had been bad since the accident. At this time hearing right,



whisper four feet; spoken voice twenty feet. Caloric test no reaction.

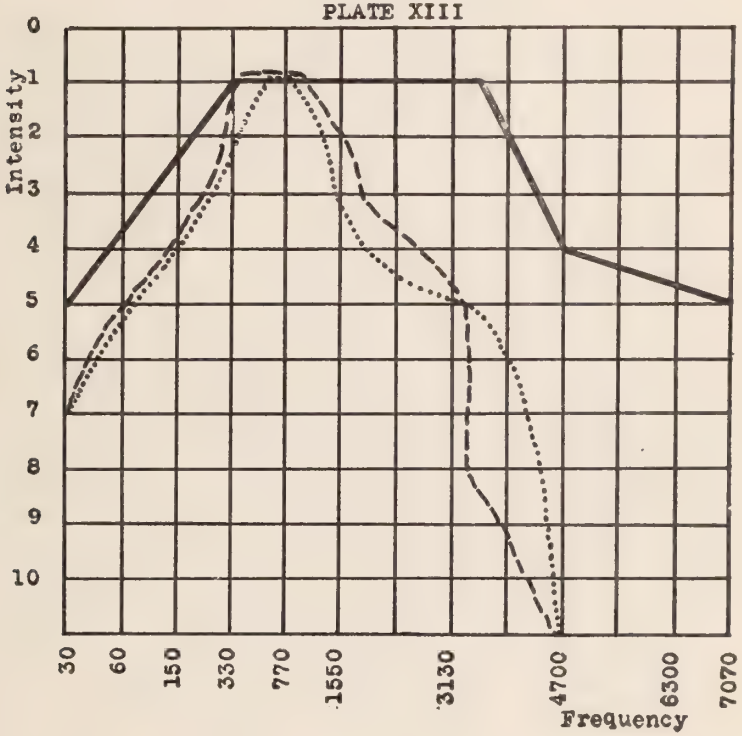
On February 3, 1920. Right, whisper one foot; spoken voice ten feet. Caloric test positive.

The curve was secured on February 10, 1920. The high notes are very poorly heard in the right; somewhat diminished in the left.

Plate XIX. Concussion Deafness.

Following explosion of hand grenade, unconscious for two minutes; hearing gone for one week. There was a gradual return of hearing until at the time of examination there was just a little defect in the left ear.

Hearing: Right, whisper twenty feet: spoken voice sixty feet. Left, whisper twenty feet: spoken voice sixty feet.



This patient was very anxious that no defect should be found present. The audiometer showed the defective audition for the high notes left.

The records presented are typical of the findings in a variety of ear cases. The test is imperfect in so far as it fails to cover the entire range of audible tones. The definiteness and accuracy of the information secured, ease in conducting

the test, the maximum attention with minimum of fatigue due to listening to a constantly changing sound, the new information derived, these in connection with the opening of new fields of research amply justify the use of the audiometer.

PLATE XIV

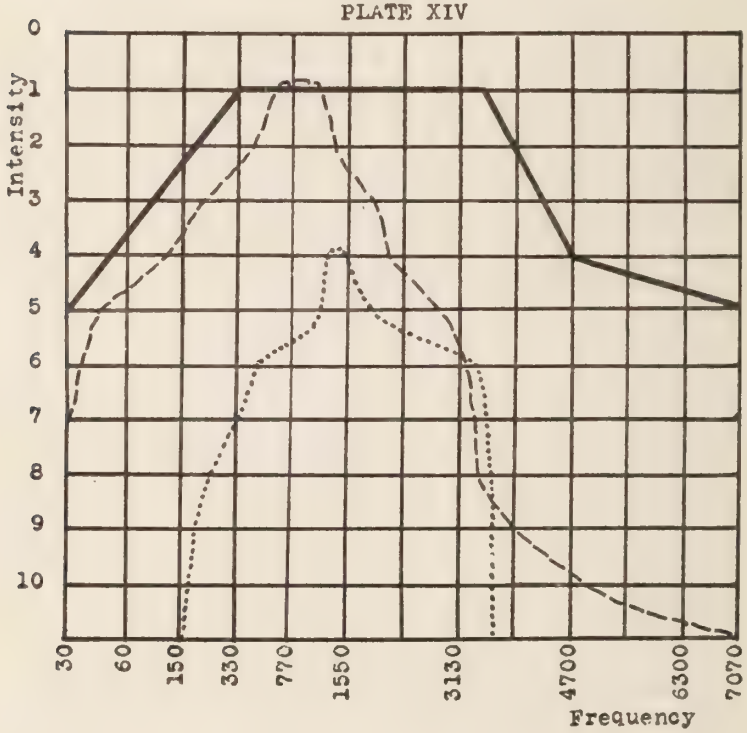
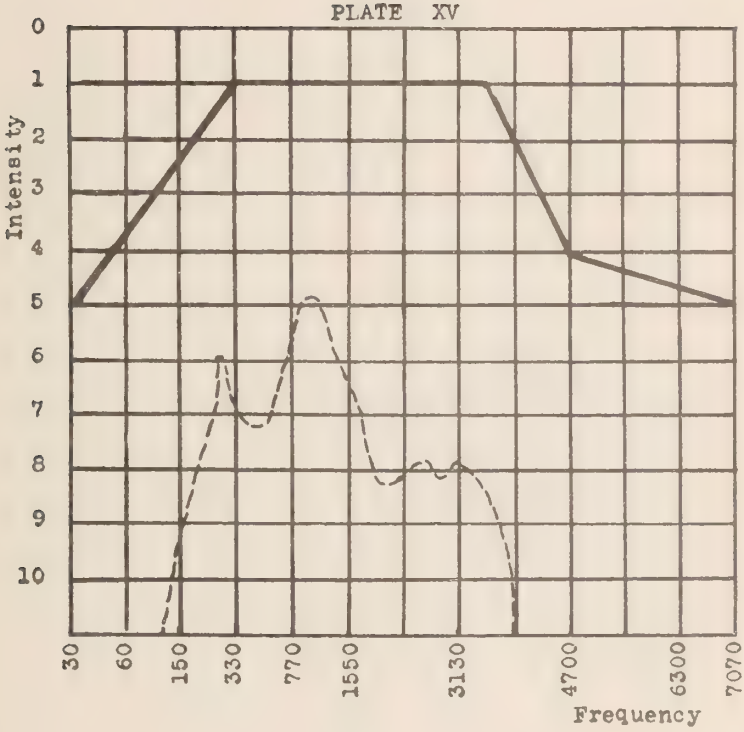


PLATE XV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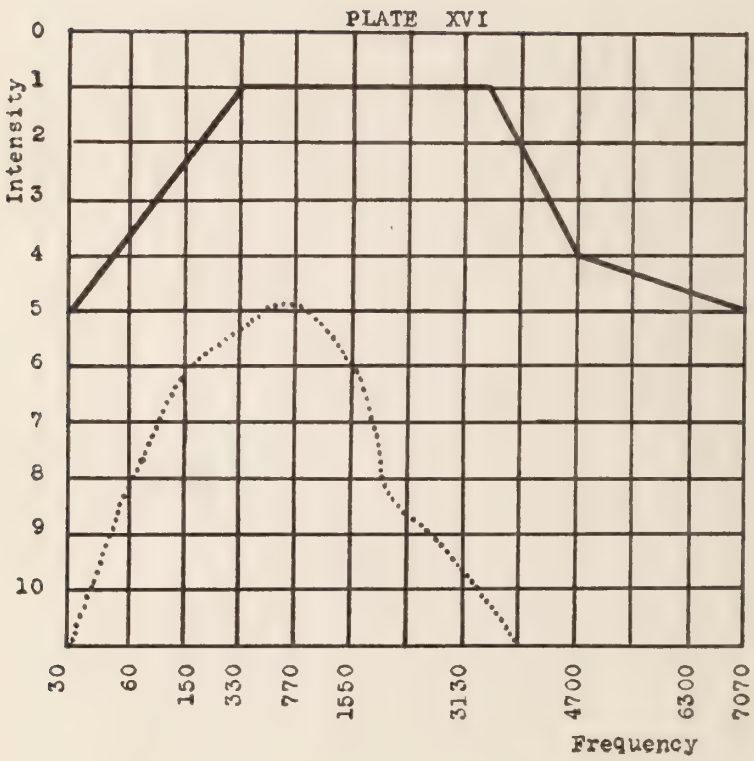
PLATE XVI
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PLATE XVII

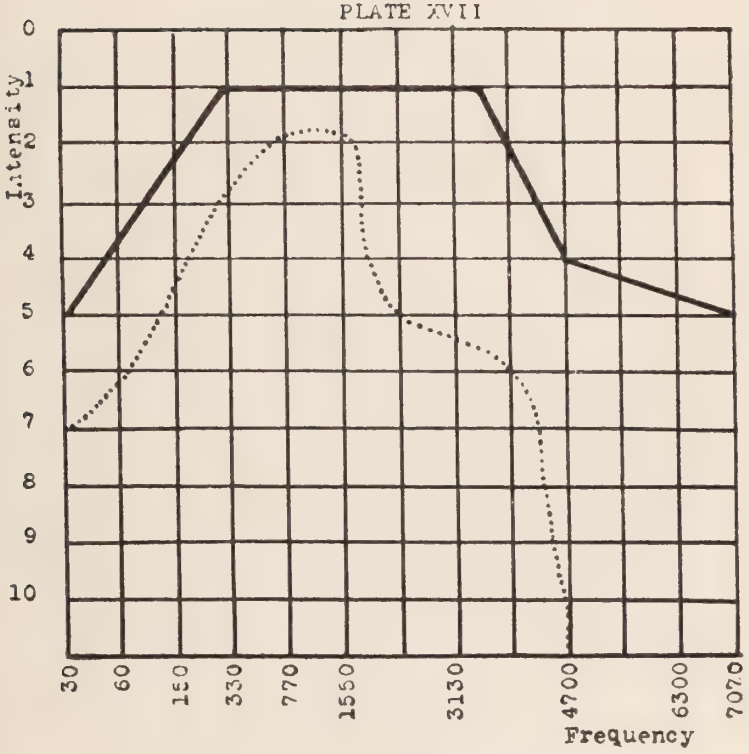
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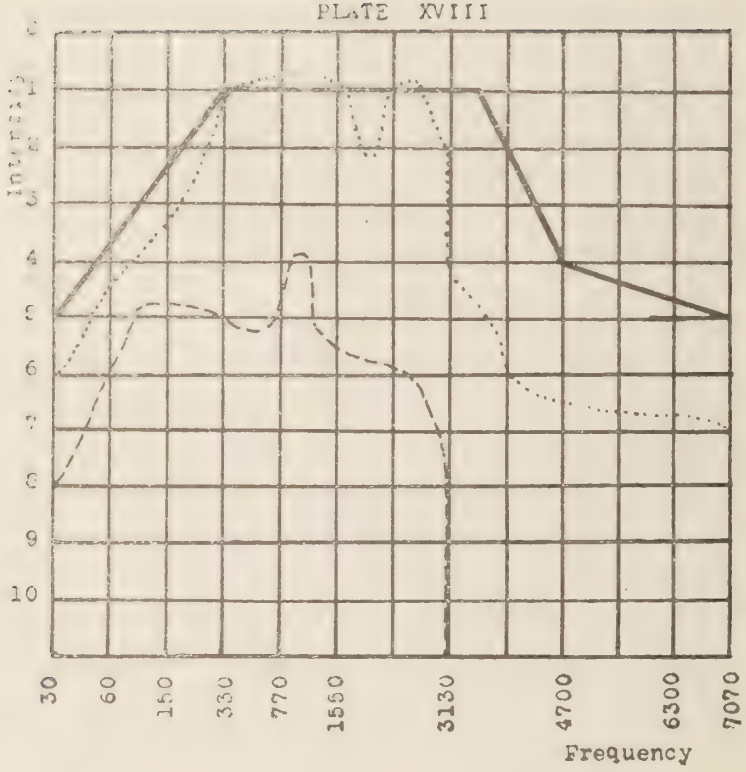
PLATE XVIII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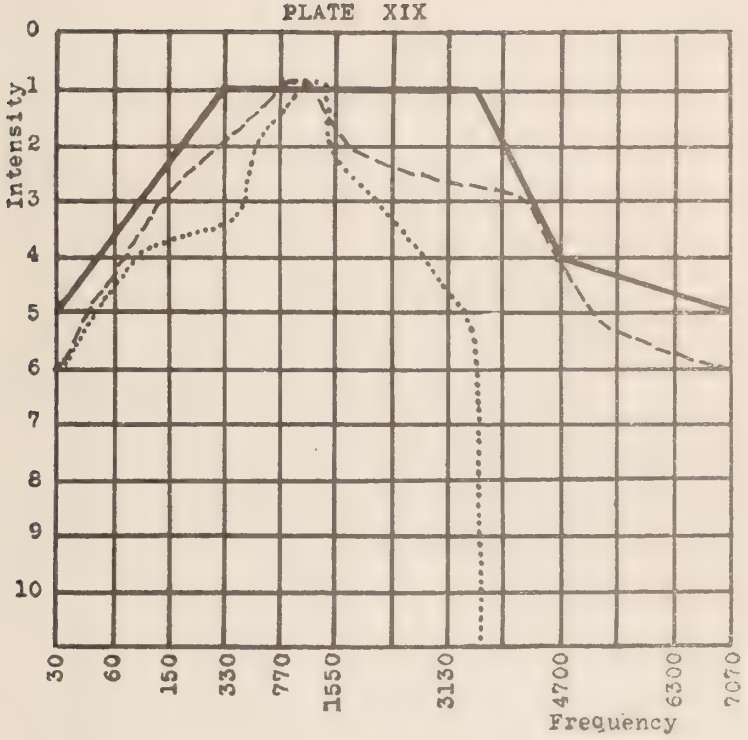
Frequency

PLATE XIX


Intensity
0
1
2
3
4
5
6
7
8
9
10
30
60
150
330
770
1550
3130
4700
6300
7070
Frequency

Discussion.

Dr. E. A. Crockett, Boston, Mass., said that he felt he could say nothing, as he was in the position of a student who was learning. He would like to know how soon these machines were going to be available. He felt that the members would like to get them, as their records and their diagnoses would be incomplete without.

Dr. J. G. Wilson, Chicago, said that the curves shown by Dr. Dean were so different from the acoustic curves arrived at by other observers that one wished to be assured that the instrument used by Dr. Dean was not at fault. For instance, the curves shown gave a long apex line almost straight from 330 to 4000 d. v. The usual experimental curves show a drop in the intensity somewhere between 1000 and 2000 and Dr. Wilson felt that Dr. Dean ought to assure them that the minimum intensity was being registered during the whole time. Errors, for instance, might arise in the diaphragm of the telephone receiver which has been found in the past to be a constant source of error, its own vibration period requiring to be taken into account. Again, the amount of energy reaching the diaphragm is not easily kept constant. As a result small errors in the apparatus may, as the frequency rises, lead to gross curve errors, for intensity at different pitches varies not with the amplitude, not with the vibration period, but with the squares of these factors. Dr. Wilson had no doubt that most of these had been thought of by Dr. Dean and his co-workers and one advantage of a psychologist taking part in these investigations was to safeguard another source of error the correct estimation of the threshold. The curves shown in otosclerosis if substantiated by further work will make clearer the certainty of the parts involved in the disease. Such work as this is to be welcomed, for otologists in the past have taken too little cognizance of the science of acoustics, one result of which has been that aids to hearing have been relegated to the hands of instrument makers.

Dr. M. A. Goldstein, of St. Louis, Mo., said that one of the fallacies that they had had to deal with was the inconstant character of the spoken sound, whether in voice, forks or Galton whistle. There was a difference in pressure in the tones of the whistle. This was marked in the forks. If the audiometer was going to overcome the difference in pressure in the vibrations so that it could be accurately determined in the tests, it would be one of the greatest advances yet made. He endorsed Dr. Crockett's suggestion that the machine be manufactured so that they could have an opportunity of testing it.

Dr. W. B. Chamberlin, Cleveland, O., asked whether Dr. Dean had modified variations in intensity by means of this instrument.

Dr. E. Amberg, Detroit, Mich., asked if the apparatus could be standardized so that anyone in Boston could have the same opportunity of examination as anyone in Iowa. Dr. Dean had demonstrated the usefulness of the apparatus by giving the findings before and after treatment. He thought that the question of intensity was even more complicated than Dr. Wilson had said. There was a reference to this question in the Arch. f. Ohren, Nasen w. Kehlkopfheilkunde, May 16, 1917.

Dr. N. H. Pierce, Chicago, Ill., said that this was a very important piece of work and showed the results of development of team work in a university where an otologist was working with a physicist and a psychologist. He thought Dr. Wilson's remarks applied to tuning forks. He thought Dr. Dean had overcome this difficulty to a certain extent. It is a curious fact that impacted wax may give the same picture in functional tuning fork tests as nerve deafness. That would not be true for pure sound conducting deafness where changes of tension must occur if inflammation is present.

Dr. L. W. Dean, in closing, said: The audiometer was designed by Mr. C. C. Bunch, Research Assistant in Psychophysics of Otology at the University of Iowa. Mr. Bunch had done everything possible to get the machine on the market, mostly because we were anxious to have the members of this Society give it a trial. Unfortunately the audiometer is not perfect—every few months Mr. Bunch makes an improvement on it.

The apex of the normal curve as secured with the audiometer is broad because the audiometer as now constructed does not diminish the intensity from 1000 d. v. to 2500 d. v. sufficiently to prevent audition by the normal ear. The greatest sensitivity with the machine is about 1000 d. v. The normal curve secured with the audiometer was determined by testing a series of normal cases and taking the average result. Our clinical observations have all been comparative. With a given strength of current the absolute intensity of the sound has not been determined. It would be different with different tones. The measurement of the absolute intensity of tones produced would be a very difficult procedure.

With all machines of the same type the normal curve would be the same whether determined in Boston or Iowa City. The record of any case of defect in hearing, if constant, would be the same.

The strength of the current producing the tone is maintained by keeping the distance between the wheel and magnets constant and by using a constant strength of current in the magnets themselves. The variations in the intensity of the sound produced are secured by means of fixed resistances which can be thrown into the telephone circuit at the will of the examiner.

BONE REPAIR AFTER INJURIES AND EXPERIMENTAL OPERATIONS.

By E. H. NICHOLS, M. D., Professor of Clinical Surgery, Harvard Medical School.

Dr. Nichols said that he was a general surgeon and not an otologist; the members could draw their own conclusions from what he was going to say, and apply the principles to their own specialty. His remarks would deal entirely with the long bones: first, repair of bone; second, repair after suppuration.

Very vague ideas existed as to factors governing the shape of bones; these were two: inheritance and function. Bone had two functions; support and production of blood cells. The marrow supplied the blood making cells. The construction of the bones was according to sound engineering principles; they were built to stand stress and strain; especially was this well shown in the femur. Bone was a specialized connective tissue. The homogenous intercellular material contained lime salts.

Experimental work had been done in rabbits. In regard to the process of repair after injury, holes were drilled in the femur where formation of external callus is slight. The repair was then found to be from the external membrane or the periosteum and the endosteum, and not from the cortical bone. First granlation tissue was formed and this granulation tissue transformed into bone. In chips of bone left by the drill the granulation cells rendered the chips of bone viable. Internal callus, in experimental fractures was slight. In fractures of the long bones repair took place by the periosteum. Bone formation took place in two ways. (1) Embryonic tissue might form cartilage which later might be transformed to bone. (2) Embryonic connective tissue might form bone directly. The trabeculae were formed by periosteum and endosteum and were shaped by action of

the giant cells. The trabeculae were arranged to take up the weight bearing function to the best possible advantage. In human fractures repair is chiefly by periosteum but rarely endosteum may be the chief factor. In the Albee transplant the bone was dead, but the periosteum was living, and the bone simply formed a trellis for the transplant of the periosteal cells. The Albee graft was nothing more or less than a foreign body and by transplanting the periosteum one could avoid putting in a foreign body.

The second point to be considered was the repair after an infectious process, as an osteomyelitis. The marrow spaces and bone shaft in his case were not all full of pus. The uninfected bone formed granulation tissue to plug off the infected tissue. The involucrum in osteomyelitis had the same characteristics as the external callus formed in fractures.

The walling off of infected from sound bone was done partly by granulation tissue derived from the connective tissue of the soft marrow, and partly by new bone derived from the endosteum. The sequestrum represented the necrotic original shaft.

What principles of treatment underlie the treatment of osteomyelitis?

In the acute stage drainage of bone. If the drainage is done sufficiently early, which seldom happens, the defect produced by suppuration may be repaired by proliferation of granulation tissue and endosteal cells. In the usual case the destruction is so extensive that a sequestrum forms, surrounded by an involucrum derived from the periosteum, analogous to the external callus of fracture, while the sequestrum is "plugged off" from uninfected marrow by cells derived from granulation tissue and endosteum.

The closure of such defects is difficult. If the defect involves a large portion of the shaft the ideal way is to remove the sequestrum (original shaft) approximate the edge of the involucrum. In such cases a new shaft will form, derived entirely from the periosteum. In later stages the sequestrum may be removed, and in exceptional instances in long

bones, and often in mastoiditis, the endosteum will form new bone, toward the median line of the shaft and fill the bone defect. In long continued cases the bone defect will be surrounded by an involucrum of dense cortical bone, derived from the periosteum, with a plug at either end of the defect composed of dense bone derived from the endosteum. This involucrum and the plugs have practically no power of repair. To fill such a defect is difficult. The best way is to remove all sequestra and infection, sterilize the cavity, and then cut back through the endosteal plugs until vascular bone marrow is reached. Then allow the cavity to fill with blood clot. If this can be done aseptically endosteal bone and granulation tissue ultimately will fill up the bone defect.

OBSERVATIONS OF THE HEALING PROCESSES FOLLOWING MASTOID OPERATIONS.

By PHILIP HAMMOND, M. D., Boston, Mass.

It is still common practice to treat the operated mastoid wound by continuous packing. The old surgical adage of "allowing the wound to heal from the bottom" was dinned at us by our predecessors until we came to believe that it was gospel. No one needs to be told of the weeks, and occasionally months, required to heal a wound in this manner, or of the resultant deformity from scar tissue.

Dr. Nichols has just shown us in an admirable manner what takes place in bone following operation or injury. It would appear that the repair processes are identical, whether the bone under consideration be the temporal or a long bone. It should be noted, however, that there is a departure from the common ground in the case of the mastoid, for we have in addition to our osteomyelitis, accessory cavities through which the infection came. In most cases, these cavities (the middle ear and antrum) are still actively involved, and one who attempts to deal with the mastoid surgically must consider their thorough and safe drainage.

Within recent years, many mastoid cases, from one cause or another, have healed in an astonishingly short time. The writer knows of authentic cases of recovery in nine days; and perfect healing, or apparent healing, not infrequently occurs during the first two weeks following operation.

One of the earliest of the quick-healing mastoids was observed by our late colleague, Dr. Clarence J. Blake, and it was this incident as much as any other that induced him to accept the theory of the "blood clot method" of operating. An operated case at the Eye and Ear Infirmary was so unfortunate as to develop erysipelas practically coincident with the operation, and the mastoid wound remained unpacked and with dressings unchanged for some days. To the as-

tonishment of all, when the wound was finally exposed, it had apparently healed by primary union. Independent research carried on by Sprague, Reik, and others, established the fact that in certain cases, at least, early healing without packing was practicable. There was no denying the fact, however, that many mastoids so treated broke down, with resultant purulent discharge from the middle ear as well as from the mastoid. There also seemed no doubt that many of our worst secondary complications appeared in cases where the mastoid was prematurely closed, or partially closed, leaving unorganized blood clot or loose granulation tissue. Then, too, there was no provision for furthering the discharge from the middle ear by way of the antrum and mastoid: and there are anatomical reasons why it is impossible to render the middle ear aseptic. So, while we know that the vaunted granulating from the bottom is unnecessary, and that if the mastoid cavity were a simple opening into bone, easily sterilized, it might be closed over, allowing nature to finish the cure, we face an entirely different proposition. First and foremost, we must see to it that the discharge from the middle ear stops as quickly as possible, in order to conserve the hearing as well as to prevent reinfection of the mastoid. This duty should stand out pre-eminent above any theory or method that aims at the rapid healing of the mastoid.

It would appear, then, that this is the first thing we must accomplish in order to approximate the ideals which Dr. Nichols has just shown us. Of course, once we have overcome the infection; once the ear becomes dry, we are ready to start even with him, as if we were dealing with the long bones.

The writer believes that a gauze packing in the mastoid facilitates the escape of much fluid which otherwise must come through the auditory canal, prolonging the discharge. A wick should also be used in the canal. Occasionally, the ear will be dry inside the first twenty-four hours. Sometimes a bit of moisture will be apparent at the inner end of the canal for days. In any event, the gauze wick which has

been inserted into the canal as far as the drum should be changed daily. At each dressing the canal should be mopped dry and a fresh wick inserted. If the mastoid packing appears quite dry it is allowed to remain for five or six days, occasionally clipping a bit from the outer end if it has become dry and hard. Should the mastoid packing become very moist, even from serum, it would be better to remove it immediately, and substitute a fresh packing. All packing should completely fill the space under treatment. In average cases, the discharge from the middle ear ceases in from one or two days to a week. At about the end of the first week, healthy, fine granulations will begin to appear in the mastoid, the whole inner surface of which is visible at each dressing. Following the removal of the first mastoid packing, which is commonly of iodoform tape, plain gauze wicks are employed, taking the precaution, as above mentioned, to completely fill the cavity. This does not mean packing under pressure, however. This plain gauze is changed daily, and one can note the rapid drying of secretions from day to day. When at last the wicks are quite dry, about the tenth day, we are ready for our departure from the routine packing.

The writer would emphasize the importance of rigidly adhering to the details as outlined above, particularly as to the completeness of the packing. Time and again, following the insertion of a loose pack or wick, the mastoid becomes filled with purulent discharge; and frequently this condition can be cleared up by proper packing. If for any reason packings must be employed for so long a period that large granulations form in the cavity, the case will not be a favorable one for the next step.

Here we fall into line with the observations that have been pointed out by Dr. Nichols. We now have a middle ear which is no longer suppurative, and a mastoid cavity lined with smooth healthy granulations, practically devoid of discharge. Now if bone repair takes place along the periosteum and the endosteum, why not let these structures alone, and allow nature free hand? This is practically what we do.

The mastoid wound is completely filled with boric acid, a pad of gauze laid over the wound and the auricle gently but firmly held back against this pad by applying more gauze and a bandage. The next day the dressing is changed. No longer is a cavity visible in the mastoid. The cut edges have fallen close together; there is a stain on the gauze pad, due to the liquifying of the boric acid, but no pus. Each day the gauze pad is changed, and in from five days to a week there will be a dry crust over what amounts to a linear scar and the patient is well.

What has happened? No one for a moment believes that the mastoid is completely healed in such an incredibly short time. Neither is it healed after weeks of packing, if we may believe the results of Dr. Nichols' researches. Then we must fall back upon the belief that changes go on inside the mastoid for many months after the patient has been discharged as cured by the surgeon. What are these changes?

Long before the writer knew of the results obtained by laboratory experimentation on bones, he had observed that patients who had been unfortunate enough to have the mastoid opened more than once, after an interval of months or years, frequently had such a firm thick cortex as to give rise to the suspicion that the former operation could not have been complete. On opening this dense bone, one uncovered a space in the mastoid, devoid of cells, filled with pus and granulations. Further observation showed that this was quite common even where the wounds in the first instance had been packed until they "healed from the bottom." This began to look as if something were amiss in our theories regarding the healing of bone. If, despite persistent packing and firm granulations throughout the mastoid, ultimate healing leaves a solid cortex with an empty space under it, why pack? What becomes of the erstwhile solid granulations under the cortex? Here the laboratory man comes to our relief and tells us that they have changed to connective tissue, contracted, and so left the cavity. This would seem also to dispose of the question invariably asked when one

for the first time sees a mastoid cavity filled with powder and allowed to heal over the surface. "What became of the cavity?" Nature would appear to have its own way regarding the healing of bone, and whether we will it or no, the cavity is bound to form, and to persist. In the light of what we have been shown as to what occurs in the long bones following operation, it would appear to be a logical conclusion that, if we can deal with a fairly clean wound, the less we interfere the better. One of the things the attending surgeon must refrain from doing is to probe into the wound, or to insert a gauze wick to care for drainage. There will be practically no drainage if the above conditions have been fully met, and to tear through the newly forming cells beneath the skin is to do violence to a step in healing already well started.

Naturally there will be some cases that do not heal as they should. We still have to deal with infections of varying degrees of severity, and with patients who do not have the best of resisting qualities. If purulent discharge persists in such cases, it would be folly to attempt closing the wound.

A word as to the apposition of the edges of the mastoid wound. One expects more or less difficulty in keeping the edges well together, and frequently attempts to overcome this by secondary suturing of the wound. After prolonged experience with both methods, the writer finds that, by attention to the suturing of the soft tissues at the original operation, the periosteum comes sufficiently well together so that there is a minimum of tendency to gape when the packing is left out.

These few observations are recorded here, not with the thought that anything new or startling has been developed, but that we may analyze our post-operative care of the mastoid in detail, and that we may so shape our treatment as to put as few stumbling blocks in the way of nature's cure as are consistent with the safety of the patient. For the axiom is as true today as it was in the time of Aesculapius, "We dress wounds—God heals them."

Discussion.

Dr. J. F. Barnhill, Indianapolis, Ind., said that they all ought to know more about this subject. Healing of the mastoid wound was usually possible, just as this case illustrated, if one knew what bone to remove and from what points to remove it. The principles illustrated by Dr. Nichols could be applied; first, removal of disease. The question was when had one removed the disease; in osteomyelitis one did not know how far to go in removal of bone; second, the edges of the wound should be left in such a state that the periosteum would fall in and cover the wound as much as possible; third, in doing this it was necessary to remove the posterior wall of the external meatus down to the bridge, taking away the sharp edges of the entire periphery of the bone so that the bone formed a shallow cavity, and when the wound was free and clear the periosteum would drop down by itself, and healing should be the rule in seven days. His view concerning the blood clot dressing had changed very materially. At one time he considered it impossible and unsurgical, but he now believed it allowed of the parts dropping together.

Dr. E. A. Crockett, Boston, Mass., asked if Dr. Nichols wished the inference to be drawn that spicules of bone left in the mastoid region would become healthy and assist in regeneration?

Dr. M. A. Goldstein, St. Louis, Mo., said that one was apt to absorb new ideas and apply them as principles of surgery. Cutting down on the mastoid periosteum, as one would after an injury, was not always easy or safe. The very nature of the mechanics of the mastoid, made of the wound a deep funnel shaped cavity. Periosteal repair has distinctive characters, and in the mastoid repair must take place in the endosteum, at the bottom of the funnel shaped opening. One had to ask how this principle could be applied to the covering of the external wound; what became of the cavity; how

was the connective tissue assimilated; and what relation was there between the periosteum growing inwards and the endosteum growing outwards with occurrence of connective tissue between?

Dr. B. A. Randall, Philadelphia, Pa., said that one very important point was to be as gentle as possible in laying off the periosteum. A gouge could be inserted under the periosteum and fibers of insertion near the lip, so that its sharp edge hugged the bone, then with a side-long upward sweep the periosteum could be laid smoothly out of the way and its vitality could be preserved for the future healing of the wound. Complete regeneration had been noted in a child with mastoiditis following scarlet fever, where there had been complete destruction and a square inch of the carious inner table was removed. Seven years later she had a grippal mastoiditis and one would have said on operation, that merely a Wilde's incision had been done, so unscarred was the rounded cortex and so developed the pus-filled mastoid cells.

Dr. Nichols (closing) said that the chips of bone were in accordance with the principles of the Albee transplant. Dr. Albee could not do without complete asepsis because the bone graft was dead bone. It was a crime to operate on the shaft cut through the periosteal pus sac, trephine the bone and curet out everything inside of the bone. Drainage alone would often do the work. In cases where there was much destruction, one must get to the root of the infection. In regard to how far to go in deep pockets, Dr. Nichols said he did not know enough about mastoiditis, but he thought it would be possible to have the capacity wide enough to turn down the periosteum and apply it to the bottom of the cavity. He could not answer questions dealing with repair of cavities of the skull. In one case of operation on the skull following traumatism on the foot-ball field, there was a large defect in the skull, in a case where two handfuls of blood clot were removed. There was no defect in the dura. The man would have been barred from the army on account of

defect in the skull, but the defect had closed up completely and was never noticed. The blood supply of the head was very efficient. Cortical bone would never regenerate, but if one could depress the periosteum to the bottom of the cavity, one could get regeneration.

THE PRESENT STATUS OF THE BLOOD-CLOT DRESSING IN MASTOIDECTOMY.

By HENRY O. REIK, M. D., Baltimore, Md.

It is exactly twenty years since I made my first report on the employment of the blood-clot dressing in the attempt to procure primary healing in simple mastoidectomy, after the manner advocated by the late Dr. Clarence J. Blake. It is five years since I presented my last paper upon that subject. Perhaps you had all hoped, as I surely did, that I had spoken my last word upon that question. The meetings of this and other Otological Societies between 1900 and 1915 were enlivened by many discussions of the value of this method. Whether or not the secretary of this society felt that you were suffering greater ennui without than with these periodic discussions I do not know, but he was rash enough to invite me to say what I thought of the present status of the operation and I have been foolish enough to accede to his request.

In the beginning, let me say that I have absolutely nothing to retract from my previously expressed opinions regarding the merits of this operation and nothing to add to the regulations governing its performance. If twenty years of experience with a given operation entitles one to speak with more authority than that of a novice, I may say that today I even more earnestly and enthusiastically endorse and advocate this operation than I have done at any time in the past. My personal experience with it has been increasingly satisfactory and my observation of the work of others whom I had the privilege of instructing or who had persuaded themselves to adopt it, has been most gratifying.

Upon being invited to address the Pacific Coast Oto-Ophthalmological Society at its meeting in San Francisco in June, 1915, I had the courage to entitle my paper "The Ideal Mastoid Operation." In that paper I reviewed what I had writ-

ten upon this subject in previous years, described the operation in some detail, and discussed the reasons why some operators had failed to secure satisfactory results with the method. That paper was published in the Laryngoscope for 1916 (vol. XXVI, p. 99-109) and in so far as I am concerned it represents my last word upon the subject. I believe it is an ideal operation and that it represents an ideal that is attainable; which cannot always be said of ideals.

Opposition to this operation has seemed to me to be based upon fear, ignorance, or inefficiency. Fear, on the part of those who apprehended some danger from its performance. Inefficiency and incompetency account for many failures among those who have tried the operation; these qualities being shown in their failure to maintain a strict asepsis or to perform a thorough operation, or both. Ignorance has played a much greater part than one likes to admit. During the winter that I spent in an American army base-hospital I was shocked to learn that at some other army posts some of our so-called otologists were still performing the old Wilde's incision in the treatment of mastoiditis and that others customarily spent more than an hour in their search for the antrum mastoideum.

But, in spite of everything this operation is making its way and it is being adopted by an increasing number of operators each year. I would like to call your attention to two especially valuable papers upon the subject: one by Dr. Jesse W. Downey, in the Annals of Otology, Rhinology and Laryngology, 1916, vol. XXV, p. 994; and one by Dr. K. K. Wheelock in the Laryngoscope for 1916, vol. XXVI, p. 93. In addition to other interesting statements, Wheelock says: "It has required nine years for me to arrive at a conclusion concerning the value of the blood-clot dressing which should have been immediate if tradition rather than reason had not guided my course." That I think, explains the attitude of a good many who have hesitated to accept the operation. There have been other interesting papers in favor of the method, and a few papers and many remarks in the course of discussion at society meetings advocating some modifica-

tion of the method. These modifications usually take the form of attempts to sterilize the mastoid cavity after operation, or to provide for what Mygind long ago described as secondary efforts at primary healing by allowing the wound to close after a few days of rest with a gauze drain in the cavity. Neither of these plans has any value. Chemical sterilization of the wound is not necessary if the operation has been properly performed and efforts in that direction will more often hinder than promote primary healing. Secondary union is not primary union and it can be just as well attained under its proper name as by calling it a modification of the effort at primary healing. In my opinion, all these efforts at modification of the blood-clot operation have simply been efforts to excuse oneself for imperfect surgical work.

I hear of men successfully employing this operation as a routine measure in many of the smaller cities, from Baltimore to Modesta, Calif., and from Seattle, Wash., to Waco, Tex. It has not yet found favor with the leaders of the profession in the large cities but I have no doubt that in the course of time it will win its way even against the natural difficulties in those places. It is the ideal operation, it is steadily advancing in favor, it will ultimately be generally accepted.

Discussion.

Dr. C. W. Richardson, Washington, D. C., said that ten years ago he attempted this work in selective cases, those in which, at the time of operation, he had thought the operation was as perfect as could be accomplished. He thought all diseased tissue had been removed and there was no exposure of the dura. He was delighted with the favorable results obtained in these cases, even in bilateral operations in which both mastoids healed up promptly. About two months ago he operated on a woman with chronic suppurative ear; the case had been seen by a good man in New York and he advised a simple mastoid, rather than a radical. Dr. Richardson said he was opposed to doing a simple mastoid, but the

patient's family wanted it and he did it. After the first dressing on the third day, everything was in perfect form, but the next day a violent suppuration of the middle ear started. Apprehensive as to the condition of the blood clot, broke open the wound, but there was an almost perfect blood clot formed and organized. He decided to let things take their course and did not remove it. Four days later the ear ceased suppurating and in six days the wound closed. In ten days there was a completely healed mastoid with a non-suppurating ear.

Dr. G. Shambaugh, Chicago, said he did not follow Dr. Richardson. What was the reason for doing a radical mastoid. Was there caries there, or cholesteatoma?

Dr. Richardson said no; simply diseased cells.

He mentioned this case because he was sure it was very rare for one to have an opportunity to see a perfectly organized clot filling up the mastoid only four days after the operation. He believed regeneration in this case was due to the fact that the periosteum was brought perfectly over the operative area.

Dr. Shambaugh said that they found themselves modifying a great many former ideas. At one time he thought it was always necessary to open the antrum. Now, if he found softened bone around the antrum, he cleaned this out, but usually he did not clean out the antrum. In regard to packing of the mastoid, he did not use blood clot dressing but put a small wick in without packing the cavity, letting the periosteal flaps collapse. This was in accordance with the principles expressed by Dr. Nichols.

Dr. Lewis asked what he did with the zygomatic cells. Dr. Shambaugh said that where he found evidences of softening in the region of the zygomatic cells, these were thoroughly cleaned out, but he did not find it necessary to open the antrum in order to do this.

Dr. Friedenwald, of Baltimore, said he was stimulated years ago by Dr. Reik's work to use the blood clot method. Most of them at the Baltimore Eye and Ear Hospital were satisfied, but not as enthusiastic as Dr. Reik.

The expression "well selected cases" had been used in the discussion to signify those which had been thoroughly cleaned out and all diseased tissue removed. But "well selected cases" were such as had for one reason or another been allowed to go on for some time and in which the inflammatory process had become well defined. One can close these wounds with the blood clot, confident that they will heal. The large number of cases opened early are not well suited for the blood clot dressing.

When the mastoid wound, in spite of careful dressing, tends to close, leaving a fistula, the most satisfactory treatment was to reopen the wound, curet it thoroughly and close it with blood-clot.

Dr. C. W. Richardson of Washington, D. C., said that the last speaker intimated that the selected cases were the badly operated cases. He would beg to protest against his statement. His selected cases had been his own, well-operated cases. It was unusual for him to have cases suppurate.

Dr. B. A. Randall, Philadelphia, said that the mastoid had to do a certain amount of ripening, as Sprague of Providence taught, before it was ready for operation. He had seen his youngers and betters rush in early in the disease, before demarcation and have to operate twice when once was perhaps too often. In regard to the blood, some did not even allow the blood to clot in the wound, but closed over fluid blood, with no provision for draining the serum, yet the clotting was essential. From his experimental studies of vessels after ligation he knew that the fibrinous blood-clot could take an important though secondary part in the repair.

Dr. E. A. Crockett, Boston, Mass., said that speaking from his own experience he had come to the conclusion that the

healing time was no quicker with than without. There was a certain element of risk in blood clot in streptococcic cases. It would be a very bold man who would do a blood clot operation in long continued suppurating cases. The blood clot would break down. He remembered one such case with meningitis and one sinus thrombosis.

Dr. E. Amberg, Detroit said he did not use blood clot because he could not tell when the wound was mechanically, chemically and bacterially clean as mentioned by Fleischmann. He thought it was taking a chance, and the fact that Dr. Richardson explored his patient, showed he was in doubt. That the antrum in some cases need not be opened had been emphasized by Politzer in contradistinction to Grunert. That was a matter of opinion. He liked to feel in his operations that the patient took chances as little as possible.

Dr. E. A. Crockett of Boston said it had been stated that ignorance, incompetency and fear, were the three reasons why this operation was not oftener performed. That was rather hard on the men in Chicago and New York who did not perform this operation. He thought that Dr. Reik should strike those expressions out of his paper.

Dr. T. J. Harris of New York said that the discussion following this paper had justified the secretary's decision to issue an invitation to read this paper before the Society. The work done by Dr. Reik years ago was apt to be forgotten. A great number of young otologists thought their work was original.

Dr. Reik: (closing) One can always feel certain that a paper discussing the blood clot operation will "start something". I certainly had no intention of offending anybody and I thought I was rather liberal in classifying the opponents of this method. I assumed that those who possess full knowledge of the subject and who are thoroughly competent

surgeons, and who yet withhold their support from this operation, do so because of fear: many of them, some of them leading members of this Society, had in fact so expressed themselves, saying they did not employ this method because they feared the possibilities of serious complications.

Dr. Crockett: It is not fear in my case, therefore it must be incompetency or ignorance.

Dr. Reik: Dr. Crockett has spoken. If he insists upon that interpretation there is no reason why I should argue with him about it.

I have said before that there seems to be something peculiar in the atmosphere of Boston and New York which militates against the success of this operation in the hands of the leading otologists of those cities, while it is a demonstrable fact that the operation is being successfully performed in every other part of the country.

The patient exhibited today by Dr. Hammond showed a very good scar and I believe he said that healing took place in two weeks. If any of you care to stop in Baltimore sometime I shall be glad to show you a number of cases with much prettier scars, some scarcely visible, and in which the healing period was only one week. One of the speakers has said that he sees little difference in this healing time. Well, it may mean little difference to the surgeon, but I assure you it makes a decided difference to the patient.

As to the question of selecting cases upon which to try for primary healing, I would respectfully again call your attention to Dr. Downey's paper which I referred to this morning; he has made an analysis of a large number of cases in the effort to determine that point. Personally, I have avoided any special selection of cases because I wanted to ascertain what could be accomplished by taking cases as they come, and, as you know, I found it possible to get primary union in 75 percent. of those cases of mastoiditis that occurred in conjunction with acute otitis media, and in 50 percent. of the cases supervening upon chronic otitis media. In the

same way, I have not been inclined to try modifications of the method because I desired to make a clean cut issue on the true value of the blood-clot dressing. If one introduces a drain or adopts other measures which lead to secondary healing rather than primary union he is no longer dealing with the issue of primary union by blood clot dressing. Furthermore, it has surely been definitely proven that modifications are not necessary in order to obtain the best results.

As to the fear of evil consequences following the blood-clot dressing, I am not aware of any case on record showing serious complications due to this cause. Dr. Crockett has just said that he knew of one case in which the clot broke down and in which sinus thrombosis occurred. There is probably no connection between the two things, because the literature of mastoid surgery abounds in reports of cases in which sinus thrombosis appeared after mastoidectomy dressed in the old way—by gauze drain, not by bloodclot.

I was very much interested in the case related by Dr. Richardson but I may say that his experience is by no means unique; I have seen it happen many times. We prefer, naturally, to have a dry middle ear accompanying a primary union of the mastoid wound but it not infrequently happens that a slight discharge from the canal persists for a time without interfering with the healing mastoid.

Dr. Shambaugh says that he does not consider it necessary always to thoroughly clean out the mastoid antrum in simple mastoidectomy. Of course it is possible for a mastoid to heal in time through nature's taking care of infection left in the antrum or in other mastoid cells but why not complete an operation while you are about it? I cannot approve of his recommendation. And, one thing I want to make especially clear is that success in the effort to procure primary healing requires cleansing of the mastoid cavity as nearly complete as one can make it and I trust that no one will introduce the blood clot into a wound cavity that is known to be unclean and then blame the method I have been advocating if failure to procure primary healing results.

Dr. Shambaugh, replying to Dr. Reik's remark that since the infection came through the antrum, it was necessary to drain the antrum, replied that in his opinion it would be just as logical to argue that since the infection came through the tympanic cavity it was necessary to extend the operation into the tympanum, as with the radical mastoid. The antrum is in reality part of the tympanic cavity and not one of the mastoid cells. The disease for which we operate is in the walls of the mastoid cells; the obstruction to drainage is not between the antrum and the tympanum but is from the mastoid cells into the antrum. These facts are often overlooked in undertaking operations for acute mastoiditis.

THE REPORT OF A CASE OF CHRONIC SUPPURATIVE OTITIS MEDIA WITH INTERESTING LABYRINTHINE SYMPTOMS AND OPERATIVE FINDINGS.

By JOHN RANDOLPH PAGE, M. D., New York City.

The question when is it advisable to invade the labyrinth in a radical mastoid operation has prompted the following case report with a few brief references.

On August 26, 1919 a boy nine years of age was brought to Dr. Duel's clinic at the Manhattan Eye, Ear and Throat Hospital complaining of headache, dizziness, vomiting and pain in his right ear. He looked sick and emaciated and had a tendency to fall to the right when he attempted to walk alone.

Beyond noting a foul discharge through a low central perforation in the drum membrane of his right ear, nystagmus to the right and total loss of hearing in the ear, no further examination at this time was made. He was admitted for observation as a case of "O. M. P. C. mastoiditis and acute labyrinthitis" and strict orders were given for rest in bed and cleansing of the ear with as little disturbance to him as possible.

The history obtained was that since an attack of scarlet fever three years before he had had an intermittent discharge from the right ear, that four weeks before, at a time when there was no discharge from the ear, pain had developed, and when he turned his head from right to left he felt dizzy and would frequently vomit. This occurred several times a day so he was treated for stomach trouble by his family physician until he was brought to the hospital because of the discharge from the ear which had developed with a recurrence of pain only four days before. His temperature on admission was normal, the leucocyte count 9600 with 66% polynuclear neutrophiles. Within twenty-four hours

his pain had left and his symptoms had so far subsided it was difficult to keep him in bed, though the nystagmus still persisted, and on sitting up he was unsteady. He did not vomit after his first night in the hospital, and after eight days of normal temperature he gradually regained his equilibrium and was allowed to go home with instructions to return in six weeks for operation on the diseased mastoid.

The tests at this time showed a completely dead labyrinth except that there was still a slight nystagmus to the diseased ear, a Weber to that side and a slight, indefinite disturbance on *suction* in the fistula test but none on compression. Irrigation of the ear with ice water for five minutes produced no effect, and the noise apparatus revealed total deafness.

On his return seven weeks later, with the noise apparatus in his good ear, he heard a moderately loud voice at arms length, had a slow but positive caloric reaction in one minute and twenty four seconds, his Weber lateralized to the right or diseased ear, and the house surgeon recorded after rotation to the right in the horizontal plane an after nystagmus of sixteen seconds, and on rotation to left an after nystagmus of twenty six seconds, which seems likely to have been an error of record and the reverse to have been the case.

The condition in the tympanum warranted a radical mastoid operation, which when performed revealed a mass of cholesteatoma over the horizontal canal and region of the oval window. The crest of the canal was eroded but it could not be definitely determined, without the dangerous use of a probe, whether or not a fistula existed, though slight pressure with moist cotton pledgets over this area caused no movement of the eye. Because of the excellent function, further interference in this locality was carefully avoided. On removing the cholesteatoma from the region of the oval window its membrane was seen to follow the surface of the inner tympanic wall in its upper posterior part and dip into the oval window recess leaving the stapes plainly in view. In demonstrating this to some students the capitulum was touched with a small probe and the bone fell over loosely, intact but completely dislocated, leaving its seat in the

window covered with the white membrane of the cholesteatoma. The dangerous communication with the labyrinth that is usually established by such an accident was in this case prevented by the disease. No disturbance whatever of the labyrinth was noticed and the next day the hearing was noticeably improved and the caloric response to a cold solution was active and almost immediate. An uneventful recovery, with a thinly dermatized and dry middle ear cavity, was obtained.

Examination on April 3, 1920, after an absence of several months, showed no accumulation of epithelium in a cavity that was perfectly dry with the oval window in plain view.

Functional test was as follows:

Weber referred to the right (operated) ear.

Rinné negative in right ear, positive in left ear.

Bone conduction increased in right ear, slightly increased in left ear.

Lower tone limit 38 d. v. in right ear, 26 d. v. in left ear.

The 2048 fork was heard equally well in both ears but about two seconds minus in both.

The upper tone limit was 1½ Galton in both ears.

Acoumeter three feet in right ear, fifteen feet in left ear.

Whisper (numbers) fifteen feet in right ear, twenty-five feet in left ear.

Whisper confusing words such as "telephone" followed by "thirty-four" four feet in right ear.

With the noise apparatus in left ear, he heard a moderately loud voice at thirty feet in right ear.

Rotation to right after nystagmus thirty seconds.

Rotation to left after nystagmus twenty-six seconds.

After the skin over the oval window was softened with oil hearing for the acoumeter improved from three to six feet and whisper from fifteen to twenty-one feet.

Had this case been operated on shortly after the acute symptoms of labyrinthitis had subsided, say two weeks after, when the caloric test was negative and the hearing absent, the dictum (made in Germany) that a radical mastoid operation should not be performed on an ear with a dead labyrinth

without the labyrinth itself being opened to provide an outlet for any inflammatory effusion that might be set up within it by the traumatism of the operation would very likely have influenced us to open the vestibule and cochlea, particularly when we considered the erosion of the horizontal semicircular canal, as this is what we did do in a similar case where the hearing and caloric reaction had not returned after the acute labyrinthitis had subsided.

Would the hearing in this similar case have returned if we had waited longer, or had in operating confined ourselves to the middle ear and mastoid? I think not, for while in both cases there was total loss of hearing and caloric reaction there was in the subject of this report along with the total deafness and negative caloric still a nystagmus to the diseased ear and a slight disturbance on suction in the fistula test, which was not the case with the previous patient, and which emphasizes the importance of not omitting these tests. The Weber also lateralized to the diseased ear, but it will be recalled that Dr. Richards had a case in which the Weber lateralized to the side on which the labyrinth had been removed.

In regard to the dictum referred to, some respect is lent to it by two cases of Dr. Kerrison which in his absence came under my care. Both had dead labyrinths and the radical mastoid operation had been performed on both without the labyrinths being opened. Tests had shown them to be functionally dead but at operation there was nothing found in either case to lead one into the labyrinth so neither labyrinth was opened. Neither cavity showed any inclination to dermatize despite careful dressing, and in one case re-operation. This case later developed a cerebellar abscess and died. The other disappeared, probably discouraged by the prolonged delay in healing.

In the three labyrinth cases referred to by Dr. Bowers before the New York Academy of Medicine, Section on Otology, March, 1920, all of which were acute, he operated on two before the labyrinthine symptoms had subsided, opening the labyrinth in one and doing a simple mastoid

on the other, the third he let alone, which in our opinion is what he should have done in all three cases, at least until the acute labyrinthine symptoms had subsided and time had been allowed for the communications with the meninges to become sealed off. This also is his subsqeuent opinion in regard to his first case for obviously all possibility for the return of hearing in it was destroyed by the operation on the labyrinth, yet this labyrinth was no more dead to sound or caloric stimulation than was the one in the subject of this report in which both functions returned. Reference to the other tests was not made in his case except to say that the labyrinth did not respond to stimulation.

Neither Dr. Dench nor Dr. Richards (John D.) have been influenced by the German dictum. The former is not impressed by the suggestion that latent infection exists in a labyrinth forever simply because it is dead functually; and the latter is convinced after opening several dead labyrinths of long standing that while they remain functionally dead the communication between them and the meningeal fluid often becomes re-established and no *macroscopic* difference in the appearance of the dead and the normal labyrinth can be detected on opening them.

The conclusions reached are that aside from a myringotomy, where it is necessary, operative interference in cases of acute labyrinthitis is contraindicated until the acute symptoms have subsided except in extraordinary cases where other symptoms have developed which necessitate operation on the mastoid or sinus, or where in beginning meningitis it is thought advisable to sacrifice all hope of returning function to the advisability of promoting drainage through the labyrinth.

And secondly, since we are unable to determine whether an attack of labyrinthitis is of a serous or purulent nature, no prognosis regarding the return of function can be made until ample time for its return has been allowed. And further that in cases of chronic purulent otitis media which require operation in the presence of a dead labyrinth the decision whether or not to open the labyrinth depends on

the exigencies of each individual case, and that while one may be led to open the labyrinth by disease of its wall, or by the history of a comparatively recent attack of presumably purulent inflammation which may have sealed off the communications with the meninges but left the vestibule and cochlea full of pus, he may on the other hand, in a case of long standing, by invading the labyrinth open a cavity that has long since ceased to be a menace, and thereby unnecessarily open an avenue for infection of the meninges.

Discussion.

Dr. Charles E. Perkins, New York, said that the only danger in allowing an acute suppurative labyrinthitis to go on into the latent stage was that one never knew when a fatal meningitis might develop. The subject brought up by Dr. Page was near to the heart of every otologist. To encourage the idea that it was safe to wait once the labyrinth failed to respond to any tests was going further than one had a right to do.

Some years ago the speaker reported three cases of meningitis following labyrinthitis. In all three a labyrinth operation was performed. The two in which the operation was performed rather later died, but the third was saved by early interference. In many patients having meningitis follow labyrinthitis there was a stage in which the spinal fluid would show an increased cell count and other changes, before actual bacterial invasion of the meninges took place. If one decided to wait, lumbar puncture might show the patient to be in this stage and this would permit of a successful operation. This was the case in the third patient alluded to.

Dr. John R. Page (closing) said that in a series of cases of *acute* labyrinthitis he did not believe the number developing meningitis would be lessened by operation on the labyrinth—that while infection in the labyrinth in some cases might be led away from the meninges by the operation, in

others the opposite result would be obtained because of injury to the protecting barriers usually established by nature and the lowered resistance of the patient due to the anesthetic and shock of the operation. In reference to the matter of frequent lumbar puncture to determine the early onset of meningitis he thought such a procedure in a case of acute labyrinthitis unjustifiable and contraindicated, as the reduction of pressure in the spinal canal would tend to promote a flow of the infected fluids from the labyrinth to the base of the brain and thereby *cause* meningitis. As he had stated in his paper, in cases where meningitis had already developed all hope of returning function might legitimately be sacrificed in the effort to promote drainage through the labyrinth, but if one opened the labyrinth in all cases of acute labyrinthitis there would be no question about the destruction of hearing in every case, but there would be grave question whether or not the number of cases of meningitis had been lessened by such a procedure.

SIXTH NERVE INVOLVEMENT IN PURULENT OTITIS MEDIA.

By CHARLES E. PERKINS, M. D., New York, N. Y.

Since, in 1910 (Annals of Otology, Etc., September, 1910) reporting six cases of sixth nerve involvement in purulent otitis media, three of which were under my personal care, I have had but two more patients with this complication, although quite a number have come to my attention, occurring in the practice of other men, and many of these have found their way into medical literature. I take the liberty of offering you brief reports of these two later cases.

Case I. Miss M. B., a nurse in Base Hospital 116, A. E. F., was under the care of Capt. W. H. Forbes until I took charge of the oto-laryngological service on December 1st, 1918, although I saw her daily for the preceding ten days. October 13th patient had headache followed by muco-purulent discharge from right side of the nose. Cultures of nose and throat were negative as to Klebs-Loeffler. Antrum was washed out with purulent return. This was repeated daily for one week with apparent relief. Then she developed pain in both ears, for which a double myringotomy was done without relief from pain, although there resulted a free serosanguineous discharge. Cultures from this grew the K.-L. bacillus. Fever and mastoid tenderness were absent. Pain on both sides continued until October 27th, when a double mastoid operation was performed by Major Rae, surgical consultant. The mastoiditis proved to be of the hemorrhagic type, and the operation was followed by great relief from pain. She progressed favorably for nearly three weeks (November 14th) when she was seized with a violent neuralgia in the area supplied by the fifth on the left side. Two days later paresis of left external rectus developed and rapidly progressed to complete paralysis. There was inability to move the left eye, to fix the finger to the left of the median

line; immediately the finger passed this point diplopia developed. Daily irrigations of the antrum had been continued with abundant purulent return. Nasal cultures positive as to K.-L. On November 27th Colonel McKernon saw the patient, and advised a radical antrum operation, performance of which resulted in cure of nasal discharge with return ten days later of negative culture reports.

There was no nystagmus, normal spinal fluid, some vertigo, probably due to diplopia, fair hearing in both ears, and vestibular reactibility upon application of the caloric test.

The mastoid wound on the right side healed in about eight weeks, but on the left remained open, and from time to time there would be a free discharge of pus. This continued even after the abducens paralysis was entirely well, six weeks after its inception. I interpreted this intermittent discharge of pus as drainage from the petrous portion. The mastoid finally healed, and the patient made a complete recovery.

Case II. Mr. G., age 47; developed severe pain in the left ear on July 28th, 1919; a myringotomy was performed the next day and was followed by free discharge which lasted three weeks. Ten days after the myringotomy, he had severe frontal headache for one day. This did not recur. for the following three weeks, during which time the ear had become practically dry. Then he developed frontal neuralgia and diplopia. There was also a severe pain in the neck on the left side in the region of the transverse process of the axis. After having these symptoms for ten days, he was sent to me by his physician, Dr. Montgomery.

Examination on September 11th showed the ear dry, with an unhealed perforation in the posterior part of the drum membrane. Hearing good. No stiffness of the neck on passive motion, but he held his head over to the opposite side, and was rather careful about active movements. The seat of pain in the neck was not tender on pressure, nor was the mastoid. Complained of diplopia and poor vision. The external rectus could completely abduct the eye, but

after a short time failed to maintain it in this position. X-ray showed nothing positive. Smear from ear negative.

He went on this way for about three weeks, having more or less frontal pain, subjectively impaired vision, and pain in the neck, the ear remaining dry with good hearing. Then, there was a free discharge of pus from the ear containing the streptococcus capsulatus. X-ray at this time showed the mastoid slightly more cloudy than at the first examination. Examination of eyes showed no more than a slight paresis of left external rectus.

Mastoid operation done on October 7th. The bone was sclerotic throughout, except for a few small cells near the antrum. No pus found. The dura was uncovered in the middle fossa, and free bleeding occurred very much as when the sinus is wounded slightly. This must have been from a persisting petro-squamosal sinus, or a large dural vein. I was very much disappointed with the operative findings. Nevertheless, the frontal neuralgia and diplopia improved immediately, the latter being absent after two weeks, while the pain became progressively milder until he was free from it some six weeks after the operation, noticeable anesthesia of the frontal region still persisting. The pain in the neck did not improve. I had become convinced that, notwithstanding the mildness of the abducens involvement, this case belonged to the Gradenigo syndrome class, when one month after the operation (November 7th) I discovered a retro-pharyngeal abscess, the lower limit of which was opposite the middle of the left tonsil. After opening the abscess at its most dependent part, a curved applicator could be inserted and directed upward to the base of the skull. The pain in the neck now became better, and he began to hold and move his head in a more normal manner. The fistula in the abscess discharged for a while, but healed completely in about eight weeks. He began to gain weight and become strong again. The mastoid wound finally healed, and the hearing was but slightly reduced. He has remained well now some four months since being under treatment.

I will not go into the anatomy of the region at the apex of the petrous portion of the temporal bone, but refer anyone interested to my original article and to one recently written by Dr. John Wheeler (Journal of the A. M. A., November 23rd, 1918, Vol. 71, p.p. 1718-1722). I wish to present this specimen which shows large cells in the petrous apex.

The first case reported above is an ordinary one of the Gradenigo syndrome, appearing after the mastoid operation, and presents no points calling for special consideration. The second, however, has several interesting features.

In an analysis of ninety-four cases of abducens paralysis occurring as a complication of otitis media purplenta, six were found to have developed abscesses in the neck, and in four of these the location of the abscess was retro-pharyngeal. Retro-pharyngeal abscess, therefore, is somewhat rare. When it occurs, it demonstrates positively that the suppurative process has invaded the petrous tip and broken through the lower surface of the bone, its approach to the upper surface being shown by involvement of the soft structures, namely, the Gasserian ganglion producing neuralgia, and the sixth nerve resulting in disturbance of function of the external rectus oculi. The Gasserian ganglion lies in much closer relation to a cell, occupying the petrous tip, than does the sixth nerve. In infective processes extending to such cells, we would expect the ganglion to become involved sooner and more frequently than the sixth nerve. It undoubtedly does become involved sooner, and that the sixth nerve does not escape oftener is due to the fact that, as it passes over the petrous portion, it is encased in a more or less unyielding canal (Dorello's canal) swelling of the walls of which results in pressure and disturbance of function. Notwithstanding this anatomical arrangement, which makes the nerve more vulnerable, there may be disturbance of the Gasserian ganglion, evidenced by severe neuralgia, without at any time in the history of the case, there being any abducens paralysis. Therefore trigeminal neuralgia, otherwise unaccounted for, occurring on the side of a suppurative middle ear process,

should direct one's attention to the probability that the infection has extended internal to the labyrinth, and due weight be given to this fact in coming to a conclusion in any given patient.

The severe pain in the neck, I believe, was associated with and in some way caused by the process forming the retropharyngeal abscess. The involvement of the periosteum and adjacent structures on the inferior surface of the petrous portion, and the tension necessary for the pus to break through into the retro-pharyngeal space would account for it. And the fact that the pain was most severe while the abscess was forming, became milder when it was fully formed, and disappeared with its cure, lends plausibility to this explanation.

Finally, given a suppurative middle ear process, caused by the streptococcus capsulatus, associated with a sclerotic mastoid portion, one may expect the process to extend internally if the anatomical arrangement is at all favorable. Under these circumstances, a cell in the petrous tip has very little chance of escape. While the mastoid operation seemed so disappointing as to its findings, it evidently did increase the drainage, although not sufficiently to prevent the retro-pharyngeal abscess: still enough to produce relief to the diplopia and neuralgia. In both of the patients, the discharge from the mastoid wound was so great that, to account for it, it was necessary to assume the presence of some internal reservoir of pus, and this drainage was facilitated, if not made possible, by the free opening of the mastoid antrum accomplished by operation. So, while recovery from the Gradenigo syndrome is possible without operative intervention, I believe that the syndrome itself without apparent mastoid involvement is sufficient justification for a mastoid operation at least. A case reported by Maybaum (Laryngoscope, March, 1920, p. 138) lends point to this observation. The ear had become dry, the neuralgia and abducens paralysis had been improving for ten days, when a fulminated type of meningitis developed, and the

patient died within twenty-four hours. No doubt these fatal cases will occur in spite of operation. It seems probable, however, that their number would be lessened if early mastoid operation were the rule.

Discussion.

Dr. L. W. Dean, Iowa City, said he recently had a patient with thrombosis of the jugular bulb on the right side. Following the operation the patient developed bilateral papilloedema and paralysis of the sixth on the opposite side. Examination of the spinal fluid was negative. There was a gradual recovery. He felt that the patient had an infection following the sinuses of the base of the skull and probably the cavernous sinus of the opposite side was affected.

Dr. C. W. Richardson, Washington, D. C., said that he could report a case which occurred in his practice two years ago, with characteristic Gradinego's syndrome, with neurological symptoms of the eye and supraorbital region, which were the first evidences that led one to suppose that this syndrome was about to take place. The pain was exquisite and intense, but there was no evidence to bear out the intensity of the pain, so that one thought the patient was simulating. The fourth day paralysis of the abducens developed. On operation there was pus deep in the mastoid; it was followed up towards the tip and there was free discharge of serous fluid, almost like cerebrospinal fluid. The outcome of the case did not look promising. The symptoms however, gradually ameliorated, the abducens paralysis cleared up and pain subsided. The boy made a successful recovery.

Dr. Geo. E. Shambaugh, Chicago, said that he had observed this syndrome in a number of cases of acute otitis media. In some it had occurred where indications for a mastoid interference were absent. These patients went on to complete recovery without operation. He had had the unique experience in producing an abducens paralysis after

operation. The patient was one suffering from persisting purulent discharge of several months duration. The simple mastoid operation brought no improvement. After six weeks a more complete operation was undertaken. A softening in the floor of the tympanum was discovered and cleaned out. Pus was seen oozing from the tympanic orifice of the Eustachian tube, apparently coming from an infected tubal cell. In working cautiously to drain this cell, the carotid was torn. The bleeding was readily controlled by a firm pack. The next morning the patient had complete abducens paralysis on the same side. It was almost a year before he made a complete recovery of this paralysis.

Dr. John B. Rae of New York had operated on one of the cases reported by Dr. Perkins. This was a double mastoid. Both mastoids were large, of the honey-comb type and with free pus in almost all of the many small cells. It seems as if the small size of the cells is of importance. Infection readily spreads from cell to cell and, once established, promises little chance of recovery without operation. The Gradinego explanation seems reasonable in cases of this character. These cells may run to the tip of the petrous and it becomes a question of the certainty of the complete eradication of the disease at the time of operation.

Dr. T. J. Harris of New York said that the literature contained a number of cases of reports of 6th nerve paralyses following mastoid operation. How did the speaker explain these? He would like to refer to one case reported by Dr. Dench, where the paralysis followed mastoid infection on the opposite side. He would be glad to hear the explanation of this. No satisfactory explanation had, so far, been offered.

Dr. E. W. Day, Pittsburgh, said that he had seen a case of paralysis of the external rectus on the left side with mastoid involvement. There were streptococci in the cerebrospinal fluid with a large number of pus cells. Kernig and Oppenheim's sign were present and there was well de-

veloped meningitis with complete paralysis of the external rectus. After the mastoid was cleared up the patient made a good recovery, but without change in the paralysis of the external rectus on that side.

Dr. C. W. Richardson, Washington, D. C. asked if the eye grounds were examined in any of these cases. He could recall one case in which there were changes in the eye grounds that cleared up after operation.

Dr. Wells P. Eagleton, of Newark, said that he had seen one early case with Gradinego's syndrome bilaterally. He thought this was not a disease, but a group of diseases. The sixth nerve was very sensitive to pressure, because of its anatomical relationships, and that it passed over the petrous portion of the temporal bone. The last case he had seen was that of a girl with running ear, who said that she saw double. He operated on the mastoid and went in as deeply as he judged right, and the girl recovered. Two weeks later there was paralysis on the opposite side. There was a moderate mastoid on the opposite side. This was operated and the symptoms disappeared. He thought that this was due to three separate and distinct conditions: (1) cavernous sinus thrombosis—in this case the infectious process crawled in over the petrous portion, the infection was in the blood stream invading the deep cells of the petrous portion where there were five systems of cells draining towards one point, and where the involvement of any of the cells would give abducens paralysis; (2) meningitis—one of the first nerves affected by intracranial pressure would be the sixth nerve; (3) suppuration of the tubes.

Dr. B. A. Randall, of Philadelphia, said that he had called attention to the fact that some form of mercurial treatment should be used to avoid the serious plastic or purulent forms of this disease. In children inunction could be used and in adults, some other form. Paralysis of the external rectus on the same side, or on the opposite side, giving crossed

eyes, was one of the early recognized symptoms of meningitis.

Dr. Charles E. Perkins (closing) said that in answer to Dr. Rae's remarks he found that of the 94 cases analysed in his original paper, abducens paralysis occurred after the mastoid operation in 27. As a rule these needed no further operative interference. So in Dr. Rae's case the operation had been so complete that drainage into the mastoid wound was sufficient to enable the patient to go on to a complete recovery. Not all of the 6th nerve involvements following purulent otitis media belonged to the Gradinego syndrome class. Some were due to basilar meningitis, some to thrombosis of the inferior petrosal sinus. One of his original cases was due to a large extradural abscess in the posterior fossa. This man had no neuralgia and the abducens paralysis cleared up prompty following the mastoid operation. When the avenue of extension of the process was through the petrous portion or along the floor of the middle fossa, then there was disturbance of the Gasserian ganglion, with neuralgia or other manifestations of 5th nerve involvement and the case one of the Gradinego's syndrome class. In answer to Dr. Richardson's question, the speaker said that in his five cases changes in the eye grounds had not been noticed although a fundus examination had been neglected in two of them.

THE NORMAL AND PATHOLOGICAL PNEUMATIZATION OF THE TEMPORAL BONE. REVIEW WITH LANTERN SLIDES.

By NORVAL H. PIERCE, M. D., Chicago, Ill.

Dr. Pierce said that he hoped to stimulate interest in the subject. One of the mile-stones in the advances of otology, and the most important work contributed since 1885, when the functional tests for otosclerosis appeared, was this book by Wittmaack of Jena, of 291 pages, and with 111 illustrations. In order to understand the far-reaching conclusions to be deduced from his work one must study what Wittmaack regards as the normal pneumatization of the temporal bone. There were three stages of development. First, at birth, the cavum was a very narrow slit between the tympanic membrane and layer of cuboid epithelium which covers the embryological myxomatous tissues and fills the periosteum and osseous cavities of the cavum and tympanic spaces and antrum. During the first year the myxomatous tissue was reabsorbed and the cuboid epithelium followed it. At the end of the first year the cavum and antrum were hollowed out. The cavities were normally lined with epithelium and there was almost total disappearance of the subepithelial tissue. The second stage: at the end of the first year there was concentric and eccentric formation of pneumatic spaces. The trabeculae of bone were thrown up into the cavity of the antrum and its lumen was diminished by formation of bridges between the trabeculae. Thus pneumatic cells were formed inward from the roof and the floor of the anterior and posterior portion of the wall of the antrum. Next there was pneumatization of the spongy bone beneath the antrum. Coincidently there was cell formation, carried on by invasion of the cellular spaces of bone. Bone was absorbed between the antrum and narrow spaces by means of myxomatous tissue, the cuboid epithelium becom-

ing flat. By the 5th year pneumatization was complete. The third stage: this continued throughout life. Pneumatic spaces were formed in the ends produced by the net work. This process was called interstitial pneumatization. Thus the mastoids were: first pneumatic; second, spongy; third, mixed. Pneumatization might be arrested before the completion of the second stage, by some inflammatory process. Thus an otitis of the nursing infant might cause arrest of development and the persistence of embryological sub-epithelial myxomatous tissue. This might also be caused by entrance of amniotic fluid during the passage of the infant from the pelvis. This in brief was the conception of the development of the bone; thus with the persistence of the spongy mastoid, there was a diseased mastoid from the beginning. The hypoplastic otitis media of sucklings was characterized by no signs of suppuration of active inflammation. There was a typical epithelium and sub-mucous tissue. There were two types of disease process; the vascular and hypoplastic and the sclerotic. There were abnormal regions over the marius, incus and stapes which in time must cause deafness. The outlook was rather pessimistic, but one could not help seeing the correctness of the views expressed. The cuboid tissue had less resistance than ordinary tissue, which explained its liability to suppurative processes.

Dr. Randall, Philadelphia, demonstrated a series of lantern slides showing the pneumatization of the middle ear in the embryo, infant, child and adult. The mesial part of the second branchial cleft, while its outer part was closed and the external meatus was forming by an involution of the epi-blast, extended out to form the tubo-tympanic axis, from which all the pneumatic cells were outgrowths. The antrum, as the upper posterior part of the three-fold tympanum, was the center of outgrowth of most of these cells, which therefore showed the radiate relation to it emphasized long ago by Schwartze and Eysell. Its walls became fenestrated by buds of mucosa invading the adjacent bone as it grew, but its own lumen remained little changed. These pneumatic cells also grew out from the attic and could invade the

squama and zygoma just as the posterior pneumatization reached often to the limits of the backward extension of the temporal and could even pass back into the occipital or down into its condyle. An important group of cells grew inward from the tympanic lobe mouth to surround the carotid and imperil the success of our radical eviscerations. Some of these extended in to surround the internal meatus, others almost to the sella turcica, although here diploe is more usual. The unretouched photographs gave indisputable evidence that each of these conditions can be found—how often or in what proportion of cases, he hoped to elucidate on some future occasion.

Discussion.

Dr. Emil Amberg of Detroit, said that he felt very grateful for the beautiful demonstration that Dr. Pierce had given. The speaker had mentioned myxomatous tissue in the tympanic cavity. In connection therewith there was one point to be noted. The drum membrane in infants, sometimes needed to be incised repeatedly at intervals, because the myxomatous tissue sometimes remained unabsorbed in the epi-tympanic cavity, as mentioned by Jansen and Kobrak. Another point was, that the vessels between the dura and the mastoid might remain. This accounted, according to Wittmaack, for the fact that a prophylactic mastoid operation did not always prevent meningitis. This knowledge was consoling to the operator.

Dr. Pierce, closing, said that he hoped he had awakened interest in the subject and that all the members would study the book for themselves.

Dr. B. A. Randall, Philadelphia, said he would certainly read the book and he was glad Dr. Pierce had called attention to it. He believed there was no instance, whatever where there was no vascular communication through the tissue. In the adult, when the mastoid was sutured round the tegmen, ehere was theoretically vascular communication.

TRIFLES THAT COUNT FOR EFFICIENCY.

By B. ALEX. RANDALL, M. D., Philadelphia, Pa.

"Perfection is made of trifles; and perfection is no trifle," — Michael Angelo.

Not every trifler becomes a Michael Angelo; nor will any of us, unless like the great master he gives the greater part of his energies to the major aspects of his work, heeding but not stressing these minor matters. When I try to give you what may be called "wrinkles", I hope they may not with you be merely "crows' feet" as you laugh at the elder member who tries to teach you things you may have cut your medical teeth on. Our caustic friend John Green once said he "had to search the dustiest archives of the specialty to find the *new* things Dr. Blank brought out in his communications". I have little doubt that most of the points I wish to make are well known to all of you; yet it is a fair question—"Do you sufficiently impress them on the attention of those whom you teach?" It is mainly because men of long experience in our specialty have praised some of them as new or ignored, that I venture now to bring them forward.

In obtaining the history of our cases have we not commonly found that many of the patients' data are vague, contradictory or irrelevant and that we must correct them in the light of our actual findings? "I never had trouble with that ear" report patients with perforated, scarred or pus-crusted drumheads. Dr. Woakes always looked first to the drumheads of his nose and throat cases to see what tales they might tell upon the upper respiratory tract; and it is good policy to reverse this and begin in our ear-cases by examining the nares and fauces. Yet some would say that it takes too long to study these side issues—hence the importance of taking short cuts and learning to inspect the nasal passages fairly adequately by lifting the nose-tip with the thumb—spreading the ala. Most men have the patient say "Ah" to

show the faaces—have them *in*spire noisily and one can commonly dispense with a tongue depressor, as with the speculum in the nose. We cannot stop to explore the lungs, espe-

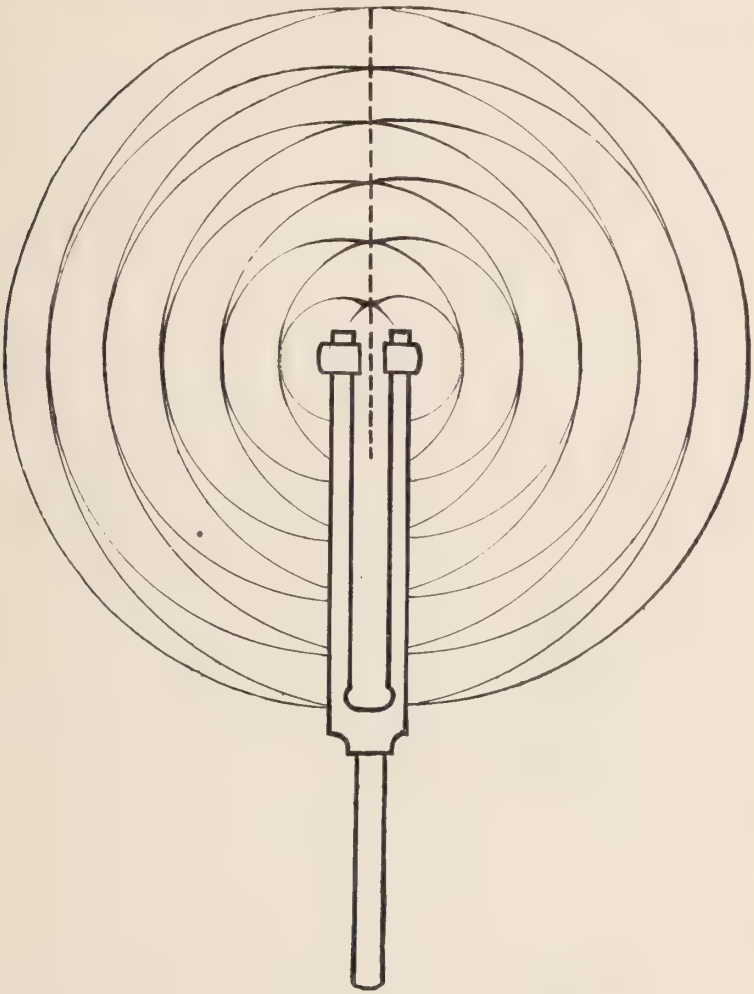


Fig 1. Sound-waves from both tines of tuning fork reinforcing and neutralizing each other, as their phases coincide or conflict.

cially with bared chest, upon suspicion of tuberculosis; but we can detect readily, even by inspection, quite surely by auscultating through the clothing, any prolongation of the ex-

piratory sound at the apices, such as is usually an early, almost prodromal sign of tubercular infiltration of that region.

In examining the auditory canal and drumhead we can often dispense with any specula if we rightly use traction on the auricle and look through the sight-hole of the mirror. An older colleague used to teach that only a beginner did this; so soon as he got out of baby-clothes he turned his mirror up on his forehead and looked under it like a master. I have always believed that this explained why in 23 years he had seen but 20 cases of attic suppuration with Shrapnell perforation, of which I reported several series of forty a year, as more correctly showing their frequency. This central illumination is doubly important in using the pneumatic speculum, where much light goes to waste, especially if it magnifies. This traction on the auricle also tells of any indurative stiffness of the canal, so we can diagnosticate eczema blindfolded.

In our testing of the hearing, does any treatise advise that the tuning fork be always pointed towards the ear so that the sonorous vibrations of each tine shall reinforce, not neutralize, those from the other? Thus, too, we get minimal palpable vibrations with maximal audible, when it might be difficult to decide whether it is heard or felt. Would the Galton whistle be as lightly regarded if its opening were always turned from the ear, its sounds elicited by successive pressures of its bulb without any *intake* of air and its orifice held near the Darwinian tubercle at the upper-back margin of the helix, where its whistle is readily heard to the limit, while its puffing is nearly inaudible? Need we cumberously time with a stop-watch the duration of bone-conduction in Schwabach's test and the normally double sounding-time for air-conduction, when the Roosa-Rinne test tells us in an instant whether the bone- or the air-conduction preponderates; and the Gardner-Brown test as quickly tells how much the bone-conduction is above or below the normal (in each ear) and helps to make the Weber test duly reliable, although it is now questioned by many who use it maladroitly? In

case of tinnitus must we scrupulously cleanse the nares and pharynx and inflate by catheter or bag to test Eustachian patulency when by Politzer's test, with the tuning-fork vibrating before the nostrils, the patient may at once tell us whether or not the tubes open in swallowing and pass the sound-waves more fully to the tympanum of one or both sides?

When our tuning-forks tell us that we are dealing with nerve-deafness (combined or not with obstructive lesion) must we get a Wassermann report—perhaps sowing discord in families, since the public is quite alive to the significance of "blood-tests"—when the evidence is already staring us in the face? Not that the serrated tooth-edges are Hutchinson's "notched teeth," as I have heard them designated; nor that the teeth of the second set need be notched to tell the story. The *pegged* teeth, with curved sides and narrow cutting edges, *widely spaced,* are almost as typical, although marking a more attenuated inheritance. I have never forgotten a boy with bad corneae not improving under the care of a skilled oculist, who did not seem to have a mere phlyctenular keratitis, although not typically interstitial. He had some percussion dullness at the apices. In spite of perfect teeth I asked of the physician who brought him as to the family history, miscarriages or other luetic evidence, but learned only of a runaway father of bad sort. At a later visit an elder sister brought him, a splendid six-foot Juno of a trained nurse, whose teeth were typically Hutchinson, justifying the anti-syphilitic medication which was beginning to secure his improvement. At her next visit she had had all notching filed out of her teeth, but they showed still their spacing and pegging. In another case, a well-developed girl of 15, the extreme deafness was ascribed to mumps and proved to be nerve-deafness. Neither she nor a young cousin accompanying her could give any significant further history and, with well-shaped teeth, I was about to accept the mumps as cause when a faint violet injection around the corneae caught my eye, the ophthalmoscope showed a vascularized interstitial keratitis and a closer look showed the teeth to be

artificial. In a wholesome-looking girl of 15 the upper incisors must have been pretty bad to require this replacement. She improved distinctly but not lastingly under anti-luetic treatment. In many other cases where the taint is doubtless acquired and the teeth are normal and the hard palate not suggestive, the velum shows brick-red quadrate patches which Carl Seiler called attention to as positive evidence of syphilis. These are not marginal, as are most palatal injections, but symmetrically placed nearly in the middle of each side of the soft palate.

Of course it should be needless to refer to the typical specific facies, with scarred mouth-angles, exaggerated naso-labial lines, saddle-nose and specific Tarsitis which may accompany and accentuate the Keratitis. In examining the pharynx and larynx we have the good general rule that posterior lesions are tubercular, anterior syphilitic. Where all such evidences of organic disease are lacking, how often we do note the scalloped, tooth-marked margins of the tongue that tell of flabby, neurasthenic physique as the cause of reduced nerve-power and call for Nux vomica.

As in the inspecting, so in the treatment of the nose and throat these simple measures are of great convenience. The thumb not only serves to reveal the anterior nares but as a rest for the atomizer-tip relieves all chance of giving or receiving infection by its contact, makes injury through sneezing or other sudden forward movements of the patient unlikely, while the slight abrasion of the mucosa which the spray itself can cause is obviated by the distance of the tip outside the nose. Have the patient slightly open the mouth, and he will less probably choke over the fluid, as it will collect mainly in the floor of the nose to be spilled out anteriorly or expectorated from the back, instead of being repelled by expiration or drawn into the trachea. Our Philadelphia method (Walter Chrystie) of one-hand management of the ball-atomizer makes this convenient at all times as well as at the bedside; and I rarely use the compressed-air tank in spraying, considering a pressure of 5-10 pounds adequate and usually safer; and through the catheter it is satisfactorily

used up the Eustachian tube, penetrating at least as far as by any other method. In this connection I would renew claims for S. D. Risley's method of using the ball-tipped Politzer-bag, which never jams in the catheter yet gives good pressure without leakage. Any medication of the air is conveniently

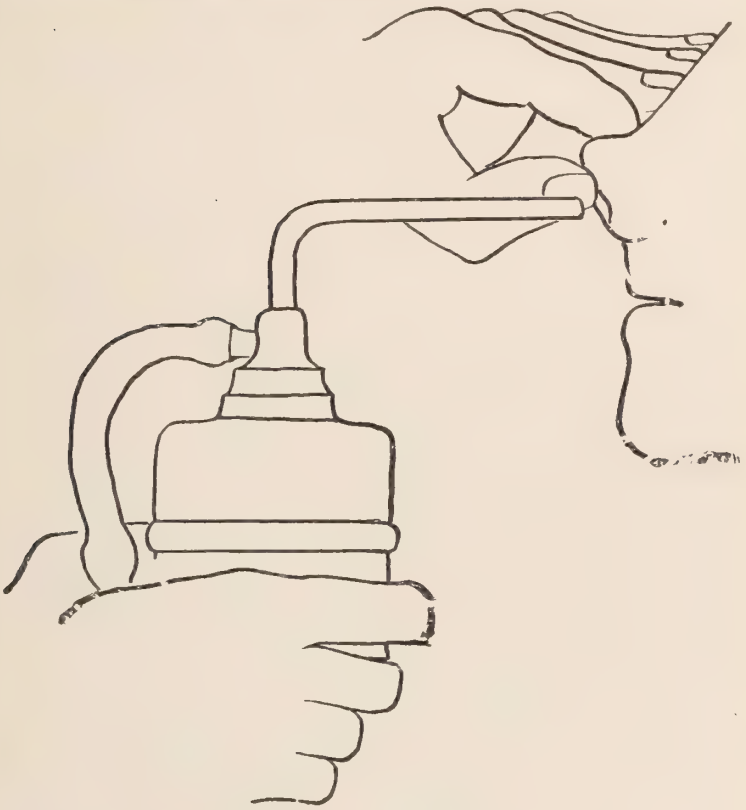


Fig. 2. Atomizer managed by one hand, thumb used a speculum and as rest for spray.

secured by merely filling the bag in the mouth of the bottle of iodine, ether, etc.; and Lowenburg's admirable test whether chloroform vapor feels *cold* in the otosclerotic tympanum may aid us in that difficult diagnosis. Incidentally it may be said that Bezold's "triad" are present in most cases of chronic catarrhal deafness and do not at all indicate, as

does this Lowenburg sign or the Schwartze flush of the promontory, a true Osteo-porosis of the labyrinth capsule.

When employing the catheter for each ear from the one nostril I have been amazed that many experienced aurists have hailed it as a new method, although it was used by Cleland and the earliest exponents of catheterization through the nose: yet it was seemingly forgotten by Voltolini and others, whose removal of nasal spurs and other irregularities was mainly to facilitate the introduction of the catheter rather than to relieve the irritation and improve the ventilation of the obstructed naris. After using the catheter it should always be wiped with a tuft of clean cotton so that any blood upon it may give evidence that the mucosa has been wounded and warn against any vigorous nose-blowing or Politzerization which might cause emphysema. I am almost afraid to state that in 40 years I have never seen emphysema caused by myself or any of my assistants, even when catheterization was entrusted to undergraduate hands. Yet I have been told that this ball-and-socket catheter-inflation is too rough to be safe! I hold that catheterization is a procedure, not "an operation"—there should be no real pain or bloodshed; and I strongly advise against cocainization.

The use of fluids per catheter, whether introduced by the atomizer or by a dropping-tube to be sprayed up by the blast of the Politzer-bag, has as one of its major values the exciting of swallowing efforts as some of the liquid escapes into the throat: for the floor of the Eustachian orifice is formed by the thinly covered Levator Palati muscle, which lifts the catheter-beak snugly into perfect position, while dilating the tube for the readier admission of the inflation.

In Politzerization it is usually claimed that the pressure must be equally towards each ear, and that we must turn to the catheter if we wish to lateralize the effect. Aside from the safe-guarding of one ear secured by closing its meatus with the finger, which furnishes a cushion of slightly compressed air to support the drumhead and even transmit a trace of counter-pressure down the tube—one rotates and inclines the head to meet the finger and thereby tends to com-

press this side of the pharynx and tube-mouth while dilating the opposite. Furthermore, the air tends more strongly toward the opposite tube, while passing by the nearer one: so it is one of the many things in otology that "go by contraries" that preponderatingly to inflate the right ear we should use the left nostril for the Politzer bag.

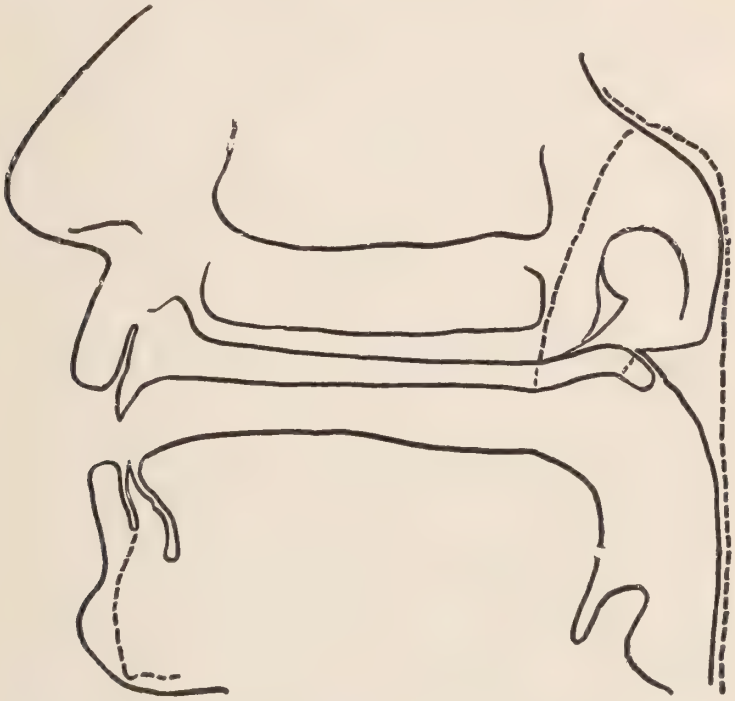


Fig. 3. Projection of upper edge of superior constrictor to form as Passavant's cushion the posterior closure of the pharynx in swallowing.

As a prelude to any form of inflation, the spraying clear of the tube-mouth region should be supplemented by mopping more thoroughly to cleanse it. In this we do well to remember, as Harrison Allen taught, that the lateral pharyngitis points definitely upward to trouble of this part of the posterior nares; and in using his applicator bent at about a right-angle we gently but efficiently reach it, if we bear in mind the jutting out of Passavant's cushion to complete the

closure of the pharynx in swallowing. Unless this is fully heeded we may fail to understand the formation of crusts which lodge above it and constitute "Thornwaldt's Disease"; or we may injure its thin edge in forcing through rather than past it to mop the vault. Squeezing out the excess of medicament is especially needful if we have the patient expose the throat by inspiration, lest its unintended laryngeal application be too irritating. Allen also urged divulsing adhesions in Rosenmuller's fossae, as did Myles a dozen years later, (Trans. Am. Ot.), and Jervey still later—now the osteopath has discovered them and is curing (?) tinnitus and all forms of ear disease by his manipulations in the vault. It is hardly inappropriate in citing Allen to call attention as he did to the value of the *aneurism-needle* as explorer of the tonsil-crypts and as our safest instrument for opening quinsy or post-pharyngeal abscess.

In douching the ear we have a splendid means of applying our best and most penetrating astringent—heat: yet many make no use of it if we may judge by the warnings against syringing in acute otitis media and the statement of Politzer and others that a temperature of about 88 F.* is to be used. We need not laboriously adjust with the thermometer (destroying our clinical thermometers if we try to employ them) to secure just the 112°-115° with which we should douche. Suffice it that you squirt the liquid on the web between the fingers to ascertain within a degree or so its temperature. To the general body-surface 105° constitutes a "hot bath"—for the inflamed ear 110° is equivalent: but at 115° your fingers report "very hot," at 116° they tend to draw away, at 117° they are snatched away, although this is really bearable. Much will always depend on the rapidity of the hot flow. Our skin is a poor conductor, not a non-conductor of heat: the impression of slow douching at 115° is about the same as a faster flow at 110°. So begin gently, letting the patient grow accustomed to the heat and realize that it is not going to be too hot or forcible; then quicken

*Luke must have been rather cold-blooded if 88° F. is "luke-warm."

the flow, remembering that there is some "back-water" in the bottom of the canal which does not give the full caloric effect. If the patient says it is "too hot" it is probably just right—if painful he howls "Ow." Oil as a means of employing heat is much inferior to water, which has double the "specific heat", i. e., each drop carries at the given temperature twice as much caloric.

Whether we use ice or dry heat to the inflamed mastoid, we do well to douche the canal frequently and fully with the hot fluid and keep the ear well protected with a bandage between-times, if we wish to do our whole duty in the abortive treatment of severe middle-ear inflammation. Indeed in influenza and the exanthems we should cover and protect the ears *before* they manifest their probable involvement. How rarely have we seen childhood ear-aches begin in the day! They almost always start after the feverish, fretful child has gone to bed and snuggled his undefinedly painful ear down to the pillow; then in sleep he turns it, hot and perhaps moist, up to sudden chill of its 102° to 104° by the room-temperature of 50° to 70°. Small wonder that he is wakened by a stab of pain that may elicit shrieks for hours. A night-cap might have obviated the whole trouble, as William Pepper taught us. This covering is almost as important as rest in bed or any other antiphlogistic measure. I can still claim that only once in a year or two do I have an acute otitis go on to mastoid operation under my care; while the red, painful mastoids that thrust the auricle far out from the head, if thus treated before they are actually fluctuating, clear up in four out of five cases. With perhaps no exception my mastoids treated with ice have required operation; of those treated with heat actual thousands have cleared up promptly and only one or two, so far as I know, with any impairment of hearing.

The methods which I have long advocated of palmar and digital pneumatic massage have as great value in drawing out secretion through the perforated drumhead or in forcing medication inward, frequently down into the pharynx. The

hydrogen peroxide, which I prefer in 65% alcoholic solution, can thus be made to froth at the nostrils in the rare cases where this much penetration seems desirable. Such medication can often replace the intra-tympanic syringing, and with good use of the attic curets and forceps will enable all of us to treat successfully without radical evisceration the majority of attic suppurations. In working in this region the surgeon will often greatly save his back and neck by kneeling on a small hassock, thereby steadying his hand and securing a more tolerant patient. Teaching as I have for thirty years that "all otitis m. pur. chron. is due to cholesteatoma" I find few "exceptions that prove the rule" and have increasing reason to reject the dictum that all cholesteatoma cases must be eviscerated. Conceding that only 26% of radical operations fail to gain virtual cure, I yet hold that another 25% of those on the list of successes might have done even better under conservative methods; for I get 50% of such cure without ossiculectomy, partial or radical. To the younger operators who report almost invariable success with retained hearing in their cases, it is fair to say that many of us have lived through that roseate experience and are sadder and possibly the wiser for it. Such optimism rarely has much chance to become chronic.

Discussion.

Dr. John B. Rae, of New York, thanked Dr. Randall for his contribution, many of the points being of importance and practical value. He desired to call attention of the members to the loose use that had been made of the so-called Bezold Triad. It would almost seem as if some men were accustomed to make the diagnosis of Otosclerosis on the finding of these three points. It should, however, be remembered that conclusions are only to be drawn from the finding of the triad when certain preliminary conditions have been met. The position may be stated somewhat thus: If we find the triad in a patient with considerable impairment of hearing, whose tubes are open and whose drum membranes do not

show middle ear changes, we are entitled to consider that we are dealing with a fixation of the stapes. Every other source of investigation should be employed to confirm this diagnosis of Otosclerosis.

With regard to the points in the triad itself only two are essential. For, given a patient who is deaf for the low notes by air conduction and whose bone conduction is increased, the Rinne *must* be negative.

Dr. Randall (closing) said that formerly the eye men diagnosed two forms of blindness, amaurosis and amblyopia: If the patient could see a little, but the doctor could see nothing, it was amblyopia; if neither could see anything, it was amaurosis. Now it seemed everything was called Otosclerosis. With a hypertrophic phase the Eustachian tube was stopped up, but only to be the more widely patulous in its later sclerotic stage. Had anyone seen catarrhal deafness in which the low tones were not the first, almost prodromally, lost. He had not, and stood ready to vigorously dispute that by any competent test such cases were true Otosclerosis.

ANOMALOUS SIGMOID SINUS THROMBOSIS, WITH REPORT OF CASES.

By JOHN F. BARNHILL, M. D., Indianapolis, Ind.

It often happens that the most difficult task of the surgeon in the conduct of an aural case, is exact diagnosis. This is especially true of sinus thrombosis, which, apparently may vary in its symptomatology from the presence of all but one marked symptom, to all the symptoms that occasionally feature the typical case of this serious disease. The family physician, and even the otologist, too often, no doubt, expects the full array of symptoms before strongly suspecting sinus thrombosis in a given patient. The accumulation of facts in the form of case reports and personal experiences leads to the positive belief that, should the development of even a majority of the classical symptoms of sinus thrombosis be awaited before arriving at a diagnosis of this disease, most cases would go on to fatal termination. It would seem, judging by the rather large accumulation of data on the subject, that few if any other serious diseases vary so much as does sinus thrombosis in its outward manifestation of clearly defined phenomena of its presence. In a partial review of the literature, and of my own experience in determining the presence of sinus thrombosis in atypical patients it seems certain that many cases have been overlooked in the past. It probably would, therefore, be helpful to emphasize what is undoubtedly a fact, namely, that sinus thrombosis, as manifested by clearly intelligible symptoms, is perhaps more often atypical than classical. Day, Friedenwald, Welty and others have reported cases in which sinus thrombosis was present without fever. It would seem incredible that infection of so large a blood vessel, or of its contents, could take place without high temperature, but statement of facts by these accurate observers cannot be disputed. Furthermore, a careful study of the methods of formation of the clot in the vein show the possibility of such an occurrence. Emerson has

reported three cases in which there was fever, but in which the temperature was atypical because much lower than would be expected in this disease—101°—102°. Many case reports show atypical sinus thrombosis in that there is an almost complete absence of ear symptoms. The rather common belief that there must be present a discharging ear, mastoid tenderness and great pain should be revised. Especially should emphasis be given to the fact that swelling and tenderness of the neck along the course of the internal jugular vein are rarely present, and only in the late, and fatal cases. In my own experience of 37 cases of sinus thrombosis mastoid tenderness has been absent in nearly 50 per cent., and in one only, a case that was septic generally, partially unconscious and near death, was there swelling of the neck along the vein. In only five of my cases have there been actual chills. Chilly sensations have usually been present, but this fact is usually ascertained only by carefully watching the patient, and by frequently quizzing the attendants concerning the point. Strabismus and other eye symptoms have likewise been rare. Only 16 of my patients were examined for optic neuritis, and but two of these had choked disc, a rather low percentage since Crockett reports 25 per cent. of his cases had choked disc, while Jansen states 28 per cent., and Jobson records two-thirds of all cases.

The presence of aural discharge is not a necessary symptom, as shown by the case of Robert Lewis and others, and by the appended report of a few of my own atypical cases. Occasionally a case is met with in which the aural discharge is absent, or apparently absent, and no history of former discharge can be obtained. Numerous cases of this class are reported. I had one such case, a patient 62 years old, who persistently denied ever having had a discharging ear. After long deliberation of the whole family, it was finally recalled that there was a history of discharge from the ear 60 years previously, since which time hard pieces of "ear wax" were occasionally removed from the canal. A plug of material resembling ear wax was present

at my first examination, which, on removal, was covered with pus at the distal end. The drum head and ossicles were gone, the patient was suffering from severe headache and fever, and at operation fluid pus filled the lateral sinus and jugular vein. Until my examination the condition of the patient's ear had never been connected in any way with his illness, although he had suffered many weeks.

There is another type of case in which there either has been no discharge at all, or in which the discharge has been trivial and has continued for only a few hours or days. Robert Lewis reports a case in which there was no discharge at all, and had been no discharge. The cases which I here report had each an acute and trivial otitis which lasted but a few hours or days, was then either forgotten or disregarded, and was later not connected with the serious illness which followed.

Case 1. Female, age about 30, while in a hospital awaiting confinement was attacked by earache which lasted a few hours and was followed by a slight serous aural discharge which continued only one day. Childbirth followed very soon, after which the mother continued feverish and prostrate for about six weeks, at which time I saw her for examination. Several physicians and one excellent general surgeon were in attendance, and from these, and from the bedside chart, I obtained a very complete history of the case. The patient apparently suffered from nothing except a septic temperature and the resulting prostration. It had been assumed by the physicians in attendance that the confinement had in some way caused the continued illness, but every effort to locate any pelvic or breast affection had been negative. Repeated blood count always showed a high leucocytosis, running as high as 20,000. No blood culture was made. Excellent X-ray plates of the head, sinuses and mastoid had been taken, which all agreed were normal. There had been no distinct chill, no unusual sweating, no headache, no eye ground or other eye disturbance. Mentality and the reflexes were undisturbed. There was, indeed, no symptom except fever, which ranged between 99 and

105°. I obtained the history of a slight earache six weeks previously and of a trivial aural discharge lasting for a few hours, after some quizzing concerning the ears. On examination of the drum head it was nearly normal and was free from inflammation. Hearing was slightly impaired. There was no evidence of any recent discharge. No tenderness was present over the mastoid or neck. All aural evidence was negative.

In view of the aural discharge six weeks previously, of the continuous septic temperature, and of the statements of trained physicians that on repeated examination no general body affection could be found, I expressed the opinion that sinus thrombosis was probably present and that exploration of the mastoid and sinus was justified.

At operation the mastoid antrum and cells were found but little if at all diseased. The sinus from behind the knee to near the jugular bulb was filled with liquid pus. The internal jugular vein was widely exposed, was ligated high up, low down, and was excised. It was blocked by a firm clot just above the entrance of the facial vein, and above the clot was creamy pus. The stumps of vein were dropped back into the wound, and, as is my plan always, the wound was closed, excepting the lower angle, where a small gutta percha drain was left for 24 hours. The patient made a speedy recovery.

Case 2. Boy, age 9, was seen first by me in a distant country home, March 12, 1916. The family physician stated that he had been ill about one month, and that his chief symptoms were a slightly discharging ear, a continued high temperature, and the resulting prostration. The temperature, which was recorded twice daily, ranged from normal to 105°. There was never any chill, pain, vomiting or other symptom indicative of intracranial complication. The discharge from the ear had been slight and differed in no way, as stated, from other harmless discharges which the doctor had often seen. The continued high temperature could not be accounted for. There was, the doctor was positive, no lung or other involvement that could produce the fever.

The little patient had been dieted and the bowels had been cleared without effect. It was thought that the ear might be the cause, but the symptoms referred to this region were, he thought, so trivial as to make this unlikely.

At the time of my visit the appearance of the patient was septic and somewhat anxious. He was greatly wasted. He made no complaint whatever of pain. His eye and general reflexes were normal. There was no tenderness, redness or swelling in or around the ear, and no evidence whatever of mastoid or other aural complication, except the slight aural discharge. The fundus of the eye was not examined. Owing to the isolated situation of the patient no blood examinations had been made. The temperature curve indicated almost certainly a bacteremia, and, since no other assignable reason for such infection could be found by repeated examination, my belief was that probably a sinus infection and thrombosis were present. The child was therefore taken to a small hospital, where further observations were made, and these more strongly pointed to sigmoid sinus infection.

At operation, March 13, 1916, the mastoid structure was found broken down, and after the removal of a thick cortex with gauges the interior was easily exenterated with the curet. The sinus was widely exposed, and, on slitting it open, creamy, yellow pus poured out under pressure. The mastoid wound was covered and isolated from the neck preparatory to resection of the jugular vein. The vein was exposed from about the third tracheal ring to near the mastoid tip, and a portion resected including the facial and superior thyroid branches. An organized clot filled the upper portion of the jugular. The septic symptoms, following the operation, speedily subsided, appetite returned and the child soon returned to normal vigor and health.

Case 3. Boy age 9, admitted to hospital March 23, 1918. He was referred for middle ear trouble and had not been very well previous to this illness having had German measles one month before. The mother said that he had scarlet spots over the breast at the onset. He now had a good

deal of desquamation of the skin of the hands; the fingers', skin coming off in rather large strips; and a rather dry skin over the rest of the body which will probably desquamate in little fine scales. A typical raspberry tongue which previously was thickly coated. Patient having been carried 20 miles in an ambulance during a raw day complained of slight chilliness on admission. Temperature 101°, pulse 96. No complaint of any kind, no headache, no pain, no nausea. Fever, weakness and a slight discharging ear were the only subjective symptoms. On physical examination there was a septic appearance. The eyes were normal to superficial examination. No appearance of acute suffering. There was a moderate amount of thick pus in the external auditory meatus, but this was in no way different from the discharge found in any acute running ear. There was not the slightest mastoid swelling, redness or tenderness. Mentality was normal, considering the condition of fever. The temperature rose to 103½° five hours after admission. Next day the highest point reached was 100⅘°. The two succeeding days it rose to 103° and then for five days the highest point was 100⅗°. The next day, the eighth after admission 102° was reached, and then for two days remained almost normal. On the 11th day a rapid rise took place, on the 12th day reaching 104°. On the 13th day the mastoid was opened and the sigmoid sinus was widely exposed and incised. Creamy, yellow pus filled the sinus which, when opened, poured into the mastoid wound under pressure. The jugular vein was exposed, ligated and excised as in case No. 2. The temperature after the operation at no time exceeded 99°, and no symptom arose which hindered speedy recovery. The child left the hospital April 25th, nineteen days after the operation, in almost perfect physical condition.

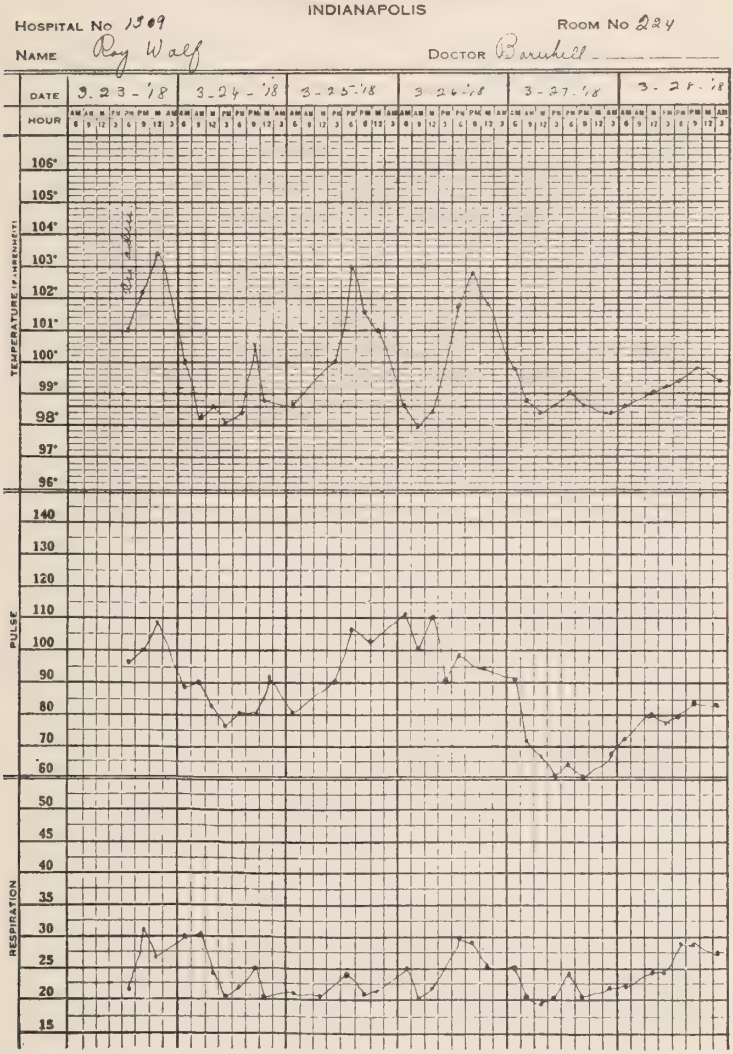
The blood count ran as follows:

On the 3rd day after admission W. B. C. was.....17400
On the 6th day after admission W. B. C. was.....26600
On the 7th day after admission W. B. C. was.....22000
On the 9th day after admission W. B. C. was.....21400
On the 11th day after admission W. B. C. was.....13000

On the 13th day—mastoid and sinus operation.....11600
On the 15th day after admission W. B. C. was.....12400
On the 17th day after admission W. B. C. was.....14400
On the 18th day after admission W. B. C. was.....13600
On the 21st day after admission W. B. C. was.....13800

One week after admission to the hospital, the slight aural discharge, which had been daily growing less, ceased altogether. At no time while under observation was there present any pain in or around the ear, or was there any mastoid swelling or tenderness. The mastoid region at all times, judging from the painstaking examinations which were made daily, was entirely normal. There was no sagging of the posterior wall of the external meatus, and, after the aural discharge ceased, the hearing improved. Eight days after admission there was soreness in the neck which disturbed the boy's rest, as it was difficult for him to find a position which gave comfort on the pillow. The neck muscles were quite tender, but on examination of the throat it was found that this external tenderness was due to a throat infection, and this finally proved the case, for when the throat improved the stiffness and soreness of the neck promptly disappeared. Had careful examination of the throat not been made this case might improperly have been reported as one in which there was tenderness of the neck as a symptom of jugular involvement in sinus thrombosis. On the ninth day in the hospital a cough came on which continued for a week and proved very annoying, and a mild central pneumonia was diagnosed by a consultant internist.

At no time during the entire hospital period was there any nausea or vomiting, any headache, mental disturbance or pain, with the exception of the painful neck muscles, as above described. Indeed, I regard this case, as the preceding ones, entirely symptomless in so far as the recorded symptoms pointed to sinus thrombosis, with the exception of the trivial aural discharge and the temperature curve.

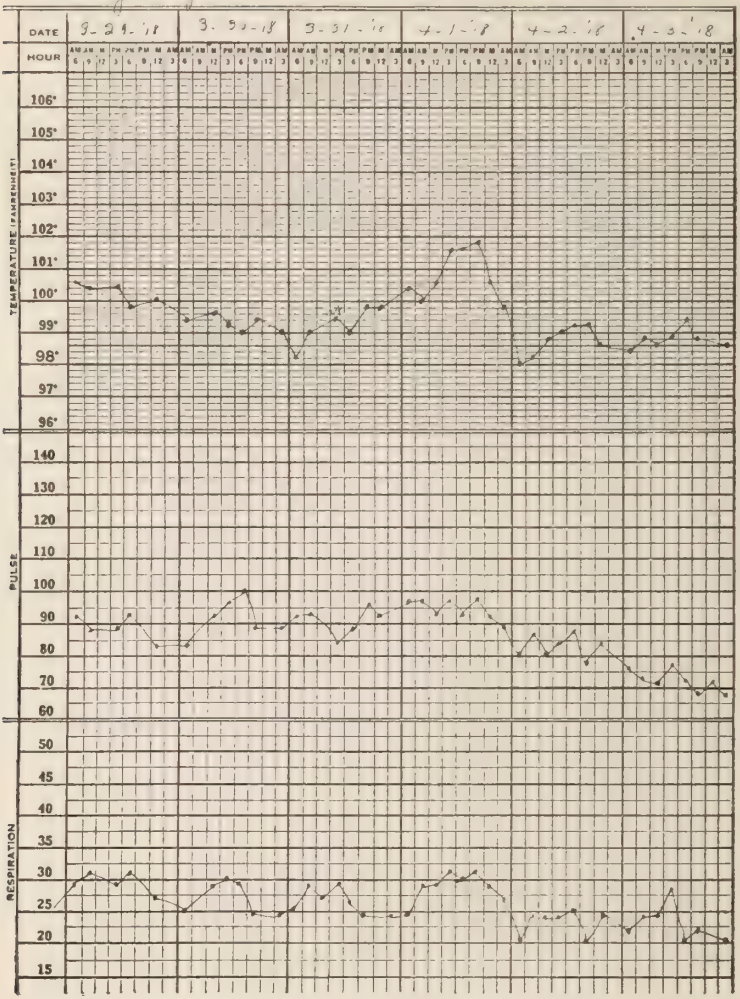

METHODIST HOSPITAL
INDIANAPOLIS
HOSPITAL NO 1309
ROOM NO 224
NAME Roy Wolf
DOCTOR Barnhill
DATE
HOUR
3-23-'18
3-24-'18
3-25-'18
3-26-'18
3-27-'18
3-28-'18
TEMPERATURE (FAHRENHEIT)
106°
105°
104°
103°
102°
101°
100°
99°
98°
97°
96°
PULSE
140
130
120
110
100
90
80
70
60
RESPIRATION
50
45
40
35
30
25
20
15

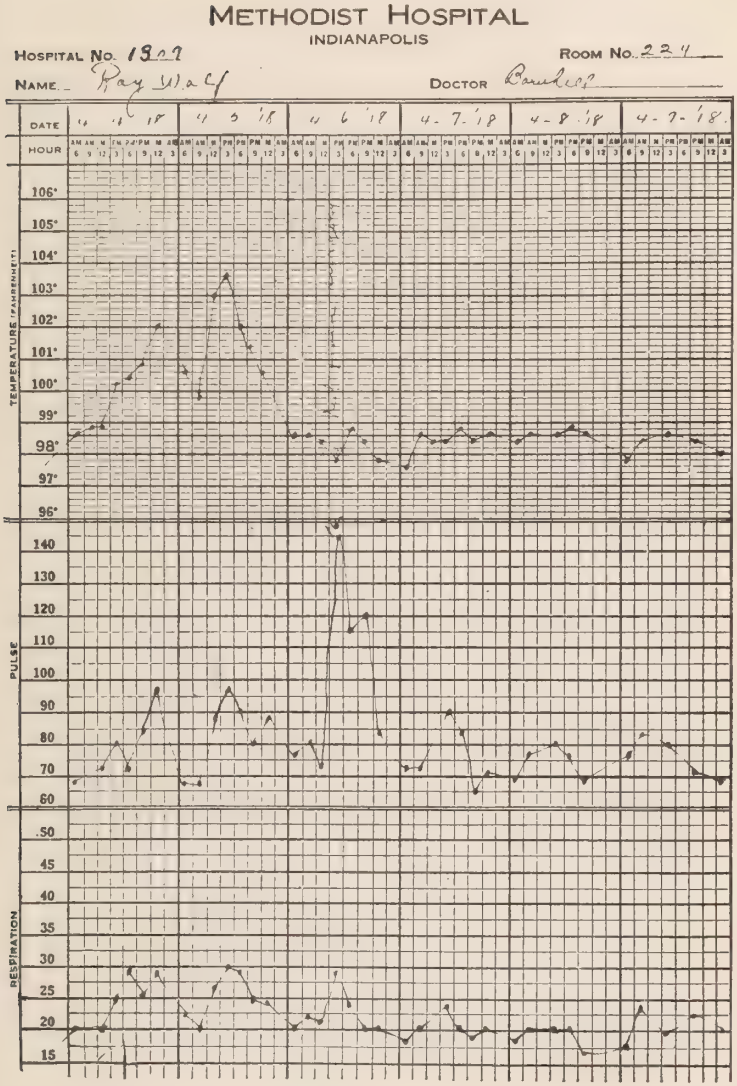
METHODIST HOSPITAL

INDIANAPOLIS

HOSPITAL No. 1909 ROOM No. 224.

NAME Ray Wolf DOCTOR Barnhill & Emerson

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INDIANAPOLIS
HOSPITAL NO. 1807
ROOM NO. 224
NAME. Ray Mac
DOCTOR Bandler
DATE
HOUR
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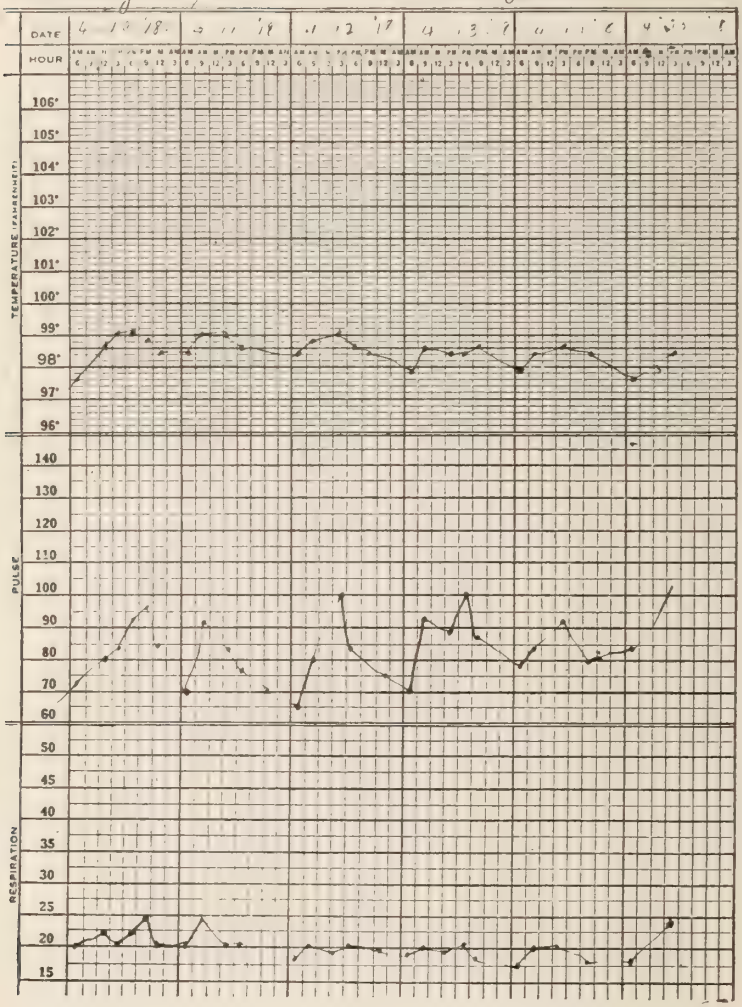
106°
105°
104°
103°
102°
101°
100°
99°
98°
97°
96°
PULSE
140
130
120
110
100
90
80
70
60
RESPIRATION
50
45
40
35
30
25
20
15

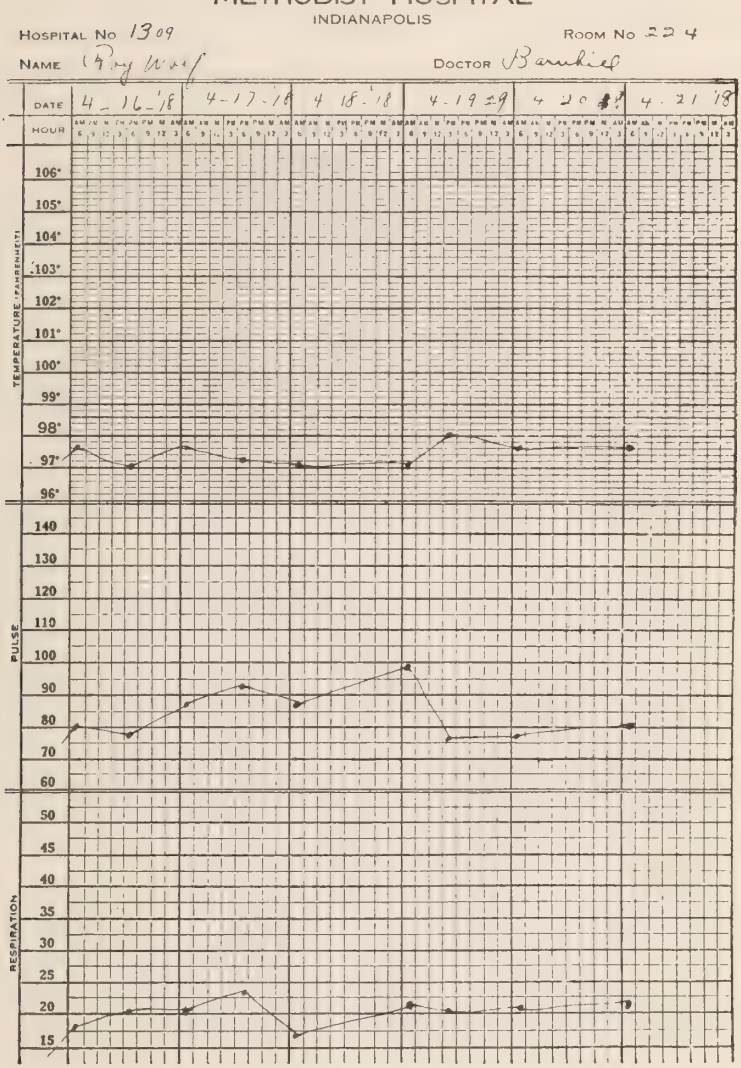
METHODIST HOSPITAL

INDIANAPOLIS

HOSPITAL NO 1309 ROOM NO 224

NAME Ray Wolfe DOCTOR Barnhill & Emerson

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INDIANAPOLIS
HOSPITAL No 1309
ROOM No 224
NAME Ray Wm
DOCTOR Barnhill
DATE
4-16-18
4-17-18
4-18-18
4-19-18
4-20-18
4-21-18
HOUR
TEMPERATURE (FAHRENHEIT)
106°
105°
104°
103°
102°
101°
100°
99°
98°
97°
96°
PULSE
140
130
120
110
100
90
80
70
60
RESPIRATION
50
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35
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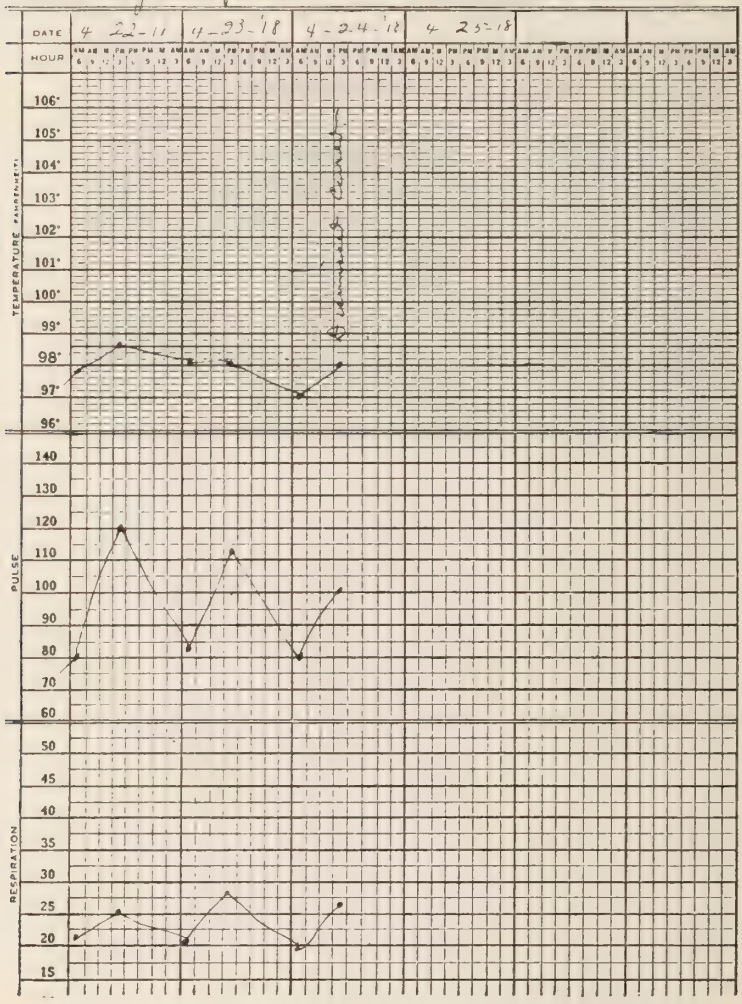
25
20
15

METHODIST HOSPITAL

INDIANAPOLIS

HOSPITAL No. 1309 ROOM No 224

NAME Ray Wolf DOCTOR Barnhill



Case 4. Report of Dr. John M. Fouts, the family physician. "Howard S., aged 13, came to my office May 1, 1920. Had some pain in right ear. A thin pus was running from ear. No tenderness of external ear or over the mastoid. Made firm pressure against tip of mastoid without complaint. Temperature normal. Appetite good. Boy was doing the work of a boy his age on the farm.

Had measles and whooping cough in February of 1911, with otitis media as a complication. After the first few days of his present illness the pain subsided, but the slight discharge persisted. At times nothing but dry scabs could be removed from the external ear. The acute exacerbation of May 1 was caused by a mild bronchitis according to the history given by the parents. The pain at this time was very slight, scarcely mentioned by patient. He assisted with the farm work until May 9th but lost in strength; was called to see him on this date. Was then confined to his bed with a temperature of 104° F, pulse of 100. Right ear discharging, no pain or tenderness over mastoid or neck. Lungs, heart and throat negative. Tender in right iliac fossa and marked gurgling over same area. Had some pain over eyes. No diarrhea but was more susceptible to laxatives.

May 10th. Morning temperature 102°, pulse 98. Slept well, no appetite, no pain, tongue coated and moist. Evening temperature 104°, pulse 100. May 11th. Morning temperature 102°, pulse 100. Evening temperature 105°, pulse 100. Complained of headache. Talked in sleep. Mind confused when aroused. Perspired some during the night and said he was chilly, but no distant chill. No pain or tenderness in ear or over mastoid. May 12. General condition same, no appetite but took a reasonable amount of nourishment. Drank water very freely. Was sick at stomach once during night. More delirious at night.

May 13. Temperature and pulse same. Some headache, some swelling below right ear which was tender. Mother said he had had this before. The first time that there had been any tenderness about ear. The left elbow was swollen and very tender. May 14. Temperature 100° in the morn-

ing and 104° in the evening, pulse from 100 to 110. Muscles of back and back of neck contracted but patient could get out of bed. Mind clear during the day and wanted to sit up. Ear discharge thicker and of bad odor, creamy. No pain or tenderness. Operation still refused and the patient declared he would rather die than go to the hospital. May 15, 16. Patient losing. Dr. J. F. Barnhill called May 17 and patient moved to the hospital May 18."

At the time of my visit the boy seemed deeply comatose, but when aroused answered questions with some intelligence. There was a stupid look when asleep. The eyes seemed normal in every way. There was no complaint of pain, but extreme irritability concerning any disturbance was evident. There was a slight discharge from the ear which was foul smelling. No pain or swelling in or around the ear or neck, except that due to enlarged cervical nodes. There was no pain on deep pressure over the mastoid. Stiffness of the nuchal muscles was present to a degree that enabled me to lift the head and trunk entirely from the bed without any flexion. A large spindle shaped, red and tender swelling involved the left elbow and the right knee. The abdomen was very tympanitic. Owing to his stupid condition it was difficult to determine the knee and other reflexes with accuracy.

In view of the absence of any lung or heart complication and of malaria or typhoid fever the diagnosis was probable sinus thrombosis. This seemed especially probable, too, since five years previously I had removed the boy's tonsils and adenoid, and at this time there was present a chronic discharge from the ear due to the measles in 1911. I had stated to the mother at the time of the adenoid and tonsil operation that the ear probably would not be cured except by radical mastoid surgery. After the tonsils and adenoid were removed, however, the aural discharge ceased and was almost forgotten. It was necessary, according to the mother's statement, to give no further aural attention than occasionally to remove what she thought were large plugs of ear wax.

May 19th the patient was transported a distance of 75 miles to a hospital in Indianapolis. The journey was not

difficult, but on arrival the condition was much worse, neither food nor drink having been taken since the day previously. There was complete unconsciousness. Temperature 102°, pulse 100. Blood culture showed a short chain streptococcus. This was transferred to a bloodagar plate, which 12 hours later showed a streptococcus growth, with complete hemolysis around the colonies, a beautiful demonstration of streptococcus hemolyticus septicemia.

Blood count on admission was: White, 18,400; polynuclears, 83%; small lymphocytes, 10%; large lymphocytes 6%; transitionals, 1%.

An expert internist again went over the case and gave the positive opinion that there was present no general disease. The boy's parents were anxious now to have a surgical operation even though the prognosis was bad, and was so stated frankly to them.

At operation a thick, hard cortex was rapidly removed with gouge and mallet, the interior of the mastoid being easily cleared with curette and rongeur. The cells contained pus and debris. The sinus was widely exposed. Near the tip of the mastoid the sinus wall had ruptured, and through the opening creamy, foul smelling pus poured out under pressure. It is my belief that the pus encountered in the mastoid cells at operation came from the sinus. The mastoid wound was covered and isolated, the jugular vein was quickly exposed, ligated above and low down, and the intermediate portion was excised. No clot or pus was found in the jugular.

On cutting down on the jugular vein a row of matted half suppurating lymph nodes were found overlying the carotid sheath. It was necessary to remove these to get access to the vein. It was these inflamed glands, undoubtedly, and not the jugular vein itself, which had caused tenderness on pressure of the neck, reported by the family physician. The boy died four hours after the operation.

A question of clinical importance is, was this sinus infected and suppurating while the boy was in his usual health, and while actually at work on the farm? It is my belief that

such was the case. Five years previously, as already stated, there was present a chronic suppurative middle ear with mastoid involvement. While the mother states that the suppuration ceased, and that the boy was well, she further states on quizzing that the boy frequently picked at the diseased ear and sometimes removed large plugs of ear wax. This "wax" was dried pus, showing that the suppuration, while less than formerly, and not sufficient in quantity to run from the ear, represented a slowed-down, but nevertheless continuous, progress with fatal termination.

Discussion.

Dr. George E. Shambaugh, Chicago, stated that he wished to emphasize the fact that sinus thrombosis in cases of acute otitis media was very likely to develop in cases where there was an absence of any symptoms of mastoiditis. One such case he observed at the Presbyterian Hospital, where a patient presented the typical picture characteristic of thrombosis of a large vein, namely the fluctuating temperature, with chills, temperature ranging from normal to 105°. In this case there was no distinct evidence of an otitis media, but a history that three weeks previous the patient had had an earache for a day or two, but no discharge. The drum membrane showed very little alteration: no congestion, only a slight cloudiness. In this case the operation discovered a thrombosis of the lateral sinus, but no evidence of mastoiditis. In another case, where the same characteristic symptoms developed, it was found that the patient had had a simple mastoid operation six months previous, in New York, which had entirely healed. Operation at this time found the bone over the lateral sinus still present. On its removal a normal lateral sinus was discovered. A week later there was a spontaneous evacuation of pus from the lower part of the mastoid wound, namely, from the bulb of the jugular. This patient also made a complete recovery.

Not long ago he was called to see another case, where there was the characteristic fluctuating temperature of a throm-

bosis and a history that the patient had had otitis media since childhood, with recurring attacks of discharge. An examination of the ear disclosed only a central perforation, no active discharge, and no evidence of a bone-invading process; not the type of ear from which we would expect a complication. Dr. Shambaugh refused to operate, believing the symptoms were a complication of puerperium. The patient had given birth to a child about a week before. This patient made a spontaneous recovery.

Dr. F. P. Emerson, Boston, said that two or three points in this interesting paper should be emphasized. First: The majority of cases gave atypical symptoms. The classical cases were less common. If one considered these cases as infections of the lateral sinus and remembered the pathology, one would understand that there were a large number of cases where there was no marked temperature. The first stage was usually that of phlebitis; the second stage was sinus thrombosis. In another class of cases there was no thrombosis, but there was septicemia. In phlebitis one might have extensive thrombosis with atypical symptoms. In Dr. Barnhill's second case there was extensive thrombosis with a temperature never above 102°, subsiding without chills. If there was a direct throwing of virulent material into the vein one might get bacteremia and these cases simulated meningitis. In cases where there was evidence of meningitis, after a mastoid operation with exposure of the sinus, one should ligate the jugular, and the case would have a better chance of recovery.

Dr. S. MacCuen Smith, Philadelphia, laid emphasis on the mental state of a patient suffering from sinus thrombosis, and felt that this would materially help in making a diagnosis, as patients suffering from this disease without complications invariably presented a good mentality, regardless of the high and irregular temperature. Dr. Barnhill's patient who became mentally dull and died probably from meningitis or perhaps a brain abscess. Most thromboses started with a mural clot which gradually increased until

it became obstructive. During this process septic material was thrown into the circulation at intervals, this causing the so-called pump-handle temperature. He asked Dr. Barnhill if he felt justified in ligation in all cases, or if he thought that a certain number of cases would recover if free bleeding was established from both ends of the sinus. Although this might not be the best surgical procedure, many cases had recovered without ligation. It was difficult at times to make a definite diagnosis on account of complications. He recalled two patients presenting classical symptoms of sinus thrombosis. Later both developed central pneumonia, which was unrecognizable at first. Each case recovered.

Dr. Philip Hammond, Boston: In connection with this subject of sinus thrombosis, it may be of interest to relate the methods used in treating this disease at the Massachusetts Charitable Eye and Ear Infirmary. These methods are based upon the cumulative experience of a fairly large staff of surgeons extending over a period of something like thirty years. In the early days cases were allowed to go on until there were unmistakable evidences of sinus thrombosis. The mortality was much greater than it is at present. It is now our custom to operate very early, frequently within the first 24 hours. It has been our experience that one can seldom determine from the appearance of an exposed sigmoid sinus whether or not an obstructive clot is present. A perfectly normal appearing sinus may contain a solid thrombus or even a broken down one; on the other hand, a sinus thickly studded with granulations may be relatively normal inside. In this connection, it is interesting to recall some of the earlier attempts at diagnosis. The very early method was to tap the sinus with a hypodermic needle to see if the fluid blood could be drawn into the syringe. Later experience taught us that such findings were not necessarily accurate as the needle could readily puncture the mural thrombus and still show a positive blood stream. Not only was this tapping

likely to err in the accuracy of its evidence, but it gave rise to positive danger. We all know that a thrombus will form at the site of injury to the intima. An autopsy performed within a short time of such puncture of the lateral sinus, it was often possible to demonstrate the presence of a thrombus approximately the size and length of a needle floating in the blood current, attached only at the point of puncture.

A long slim thrombus of this nature, of course, furnishes most excellent opportunities for emboli. The earlier surgical procedure consisted of tying the jugular vein in two places and severing the vessel between the ligatures, the neck wound being closed. Today most of our operators are content to tie the jugular without severing the vessel. Seldom does the neck wound break down. The infected portion of the vessel is readily drained from the mastoid wound. In the very worst cases, where excision of the jugular might be indicated, we believe that to sever the jugular and bring it out to the surface and fasten it to the edges of the incision, leaving it as a natural drainage tube, is a simpler and safer procedure, and fully as efficient as excision of the vessel.

Dr. C. W. Richardson, Washington, D. C., said that there were many difficulties in making an early diagnosis. Skilled internists were often in doubt when pneumonia occurred soon after operation. In one such case a frank pneumonia developed three days post-operative. In some cases the evidence went the other way. In one case seen by the speaker, he could not be sure it was sinus thrombosis but he thought it was. The woman was very emaciated, she had been ill for a year and weighed 102 pounds. She had a suppurative ear, untreated for a month. This subsided. Then she began to run an irregular temperature and the blood count was 8000 w. b. c., no increase in polys; no tenderness over the mastoid, but the ear slightly suppurating. A blood culture was then made. The family became dissatisfied and took the patient home. The family physician later said the

patient developed a streptococci infection of the elbow and knee and died of septic pneumonia. The case was probably one of sinus thrombosis, but one could not be positive and there was not sufficient evidence to warrant operation on the sinus.

Dr. E. W. Day, Pittsburgh, said that diagnosis of typical cases was easy, but few cases were typical. Absence of symptoms did not preclude sinus thrombosis. At autopsy many cases were found with obliteration of the sinus, and there was no history of the patient or by the friends to lead to this conclusion. There must be cases going around with few symptoms. After the flu epidemic, children with ear cases often showed marked debility and rise of temperature with chills and blood culture positive for hemolytic streptococci. Internists could find nothing and the cases finally recovered after a protracted illness.

Dr. Emil Amberg of Detroit said that in one case of meningismus in pneumonia he was saved from doing an operation at the last moment. One might perhaps get information from the X-ray in these cases.

Dr. T. J. Harris, New York, said that there was no more important matter for diagnosis. Yesterday the members did not know much about the papers and could not discuss them. Today the subject appealed to every man who was doing ear work. It was of interest to see if one could draw any helpful conclusions from this collective experience. They were agreed that the atypical cases far exceeded the typical cases. Was there anything that one could put one's finger on that would help more than anything else in the diagnosis. One point was recognized, and that was that symptoms differed according to the stage of the disease and that the symptomatology and pathology went hand in hand. Could any conclusions be drawn? One class of cases was not emphasized as much as it might be,—that was the perplexing class of cases with persistent temperature, following mas-

toid operation, with pneumonia or bronchitis, where the internist was hedging and saying it might or might not be sinus thrombosis, one had got to get all the help one could. He was anxious before the discussion closed, to get some definite opinions as to the value of blood culture. Would Dr. Barnhill say what conclusions he drew in his 37 cases, on this question. Some pathologists said there was a hematogenous infection without reference to the ear at all.

Dr. B. A. Randall of Philadelphia said that he feared they would not reach any consensus of opinion. In regard to sinus thrombosis, he felt like the old Westerner who said when crossing the plains, "If you see signs of Indians be careful; no signs of Indians, more careful." Some points, he thought, needed further emphasis in the discussion. They were dealing with phlebitis, and that fact was often forgotten. The phlebitis was the cause of the thrombosis. If the phlebitis was the result of a chronic suppuration, there was no self-limiting tendency. If the lesion was acute, there was organization and obliteration of the vessel. If the phlebitis was associated with eburnated mastoid, no symptoms reached the outside, but the lymph nodes accompanying the jugular showed induration and tenderness. These points would be useful to bear in mind in the majority of cases. Reik well brought out that in these chronic cases one should tie and exsect the jugular, and one got lesser mortality. Where the more severe operation had been done there was 80 per cent. of cure. Operation must be rapid without exhausting the patient, whose strength must be conserved by morphine and saline injections. Where there was evidence of pneumonia, or sepsis, or serous membrane inflammation, saline injections by rectum were without risk or opposition and controlled the sepsis. These things seemed so matter-of-course or so trifling that one was ashamed to insist on them.

Dr. H. B. Blackwell, of New York, said that it seemed to be the consensus of opinion that the diagnosis was the most important thing and must be made before one could hope

to initiate any treatment. Dr. Haskin was to be congratulated on having diagnosed two cases which were not sinus thrombosis. It was difficult to eliminate various conditions which simulated this lesion. It was his opinion and that of many others that where sinus thrombosis was established it was the thing to operate upon the sinus or tie the jugular.

Dr. John B. Rae of New York did not wish to repeat any of the points that had been raised. Nothing had been said of the presence of edema in the posterior triangle. This is associated with involvement of the posterior condylar vein, and is a most valuable symptom when in evidence, particularly in the protracted indefinite cases when the blood culture is negative.

Dr. S. MacCuen Smith of Philadelphia said that Jansen had pointed out that ligation,with or without excision, gave about the same proportion of recoveries. Still there must be a definite procedure for the type of cases that Dr. Barnhill had, with actual pus in the vein.

Dr. W. P. Eagleton, of Newark, said that he had come to the point where he did not place much reliance on the diagnosis of internists. It was a frequent occurrence to meet a diagnosis of pneumonia. When a patient had a running ear and high temperature, the internist must produce very good evidence to delay the operation. The presence of a known point of suppuration should be a sheet anchor in all diagnoses of intracranial suppuration. It was more likely the danger point should be there than in the lung. Operative mistakes were so few, compared with mistakes in waiting that he had come to believe that operation was more important. It was a matter of routine to have blood cultures taken every day. One negative blood culture meant nothing; five meant nothing, but one positive blood culture meant everything. Often the bacteriologist could make the diagnosis first. Dr. Hammond mentioned embolism, the speaker said he had never seen but one case, in a child with running ear, and what was supposed to be pneumonia. There

was gangrene of the arm and symptoms of meningitis. The speaker said he thought it was a straight case of epidemic cerebrospinal meningitis. A lumbar puncture showed cloudy fluid. Meningococcus serum was given, but the report came back that the spinal fluid was positive for streptococci. The autopsy showed sinus thrombosis.

Dr. W. H. Haskin, New York, asked where the embolus came from. It was difficult to have a large sized embolism coming through the capillaries.

Dr. Eagleton said they found thrombosis at autopsy.

Dr. B. A. Randall of Philadelphia said that in one case of suspected septic pneumonia, with bad breathing and dry cough, the infection was unrecognized by two noted internists called in on successive days; but on the third day he diagnosticated a pleural patch as large as his hand and next day at autopsy the lungs were found studded with hundreds of abscesses, some very minute, dozens as large as grapes, but one as large as an egg that by rupture had formed the pleuritic patch and could hardly have been absent when the internists had examined.

Dr. J. F. Barnhill (closing) said that there had been a splendid discussion. The subject was too big to reply to all questions that had been asked. Dr. Smith asked about removing the clot, this was not done, unless he went down upon and ligated the jugular. He did not think it wise to leave the clot there. He slit the sinus wide open. Dr. Smith had asked if he would ligate even if the clot were removed and there was free bleeding from each end. He would not ligate in that case. As to the diagnosis of pneumonia, one had to be very careful. The internist said pneumonia, but that did not mean that sinus thrombosis was not there. Both conditions might be present. When the case was discovered, one must use every means to solve the problem. One should depend on the laboratory as

much as possible and go over and over the case and get cultures and put this evidence with other things. As to ligation, he believed that the jugular should be ligated and not leave septic substances in the blood stream to be carried all over the body. Everything should be cleaned up. It did not take long to do a jugular ligation. It did not add to the danger, and it took away from the risk. The question was, when to operate. Dr. Hammond said 24 hours, but that seemed too early to make a positive diagnosis. Postponement was longer in children than in adults. The diagnosis was more difficult in children. If there was a running ear and septic temperature, the diagnosis was reasonably made and one was justified in exploring. In Dr. Richardson's case, he said he would have operated on that case. A positive diagnosis was justified and operation might have saved the woman's life.

In the next similar case, he believed Dr. Richardson would operate. Dr. Shambaugh mentioned endocarditis, that was one thing to be considered. Some of these cases of septic endocarditis looked like typhoid fever. One must eliminate sources of bacteremia, and then one was safe in going ahead. Dr. Harris had asked what conclusions were drawn. There were none except to put all these things together. The most difficult thing in the management of these cases was the diagnosis, but it was a duty not to operate in 24 hours unless laboratory reports warranted the conclusion. One speaker asked whether ligation would cure the class of cases here reported. He did not think so. There was a space of four inches of vein full of yellow pus. It would not be a decent surgical operation merely to ligate and leave the pus to kill the patient.

POPULAR FALLACIES IN THE PRACTICE OF OTOLOGY.

By GEORGE E. SHAMBAUGH, M. D., Chicago, Ill.

We are all more or less creatures of habit. This may have its advantages but it also has disadvantages. One of the disadvantages is the perpetuation in practice of methods of treatment which an increasing knowledge has long since shown to be illogical and useless. It is my purpose in this paper to point out some of the more conspicuous examples of this fact in the practice of otology.

Otology developed as a field for special practice before much was known of the diseases of the nose. An increased knowledge of these diseases brought a better insight into the etiology of the diseases of the middle ear. From that time otology as an addendum to ophthalmology ceased and the otologist became more and more a rhinologist. This situation persists to this day, the result being that many problems, especially those relating to treatment of middle ear disease, are referred back to a rhinological basis for solution, too little attention at times being given to the otological aspect of the case. The fact is well established that the acute inflammatory diseases of the middle ear take their origin with few exceptions from extension through the Eustachian tube of infection beginning in the nose and pharynx.

The fact, too is well known that sub-acute and more chronic forms of middle-ear disease often owe their existence to chronic disease of the nose and pharynx, such as hypertrophy of the posterior ends of the turbinated bodies as well as enlargement of the adenoids and of the faucial tonsils. The result has been that in cases of recurring acute inflammation in the middle ear, as well as in the chronic forms of middle-ear trouble, whether this be the chronic tubo-tympanic catarrh or the chronic suppurative otitis media, our first thought is for the correction of any existing

conditions in the nose or pharynx which may constitute an etiological factor. Right here has developed one of the most striking fallacies in the practice of otology. Too little discrimination has often been made between those conditions in the nose and throat which can rationally be expected to be a factor in the etiology of middle-ear trouble and other conditions for which there are no grounds for attributing such a relation. The most striking fallacy, I believe, is the assumption that any existing alteration in the nasal passages, especially such as the usual anatomical variations like the irregularity of the nasal septum and the compensatory variations in the size of the lower and middle turbinated bodies, are causes for middle-ear disease.

The practice of correcting all such anatomical variations in the nose in cases of middle ear trouble began in those early days of rhinology when the relationship between diseases of the nose and middle ear was first recognized. Those of us who have been more keenly interested in diseases of the ear have long since recognized that these anatomical variations take no part in the etiology of middle ear trouble except possibly in those exceptional cases where this anatomical variation is causing unmistakable nasal symptoms, especially in the form of obstruction to nasal respiration.

The impaired function of the Eustachian tube, especially where there persists a more or less permanent occlusion, was early recognized as a cause for many of the symptoms of middle ear trouble, especially for defective hearing. The practice of systematic inflation of the middle ear became a standard method of treatment for middle ear disease. The value of inflation of the middle ear in cases presenting tubal occlusion is well recognized. It is, however, one of the common fallacies of otological practice to assume that in all cases of obstructive middle ear deafness long-continued inflation of the middle ear is indicated. As a matter of fact in all the cases of primary fixation of the stapes and in most of the cases of chronic adhesive middle ear catarrh, inflation of the middle ear is not indicated and brings no results. In most of these chronic cases the tubes are not

obstructed, but are even more patulent than in a normal case. The only time when inflation is at all indicated in such cases is during the acute exacerbations when there is an increase in the ear symptoms from temporary swelling of the tube or accumulation of secretion in the tympanum.

The habit of treating by inflation all those cases with ear symptoms, those presenting symptoms of tinnitus and vertigo, as well as those of defective hearing, arose before the use of the tuning forks made it possible to make a clear differentiation between the cases of nerve deafness, primary fixation of the stapes and the chronic obstructive middle ear catarrh. In many quarters this practice is still carried out and the fact that the vertigo and sometimes the tinnitus improves or even disappears while the case is being treated, is taken as a demonstration that the inflation has been instrumental in accomplishing this result. It has been very much to the detriment of otology that we have too often persisted in useless local treatments for cases where our present methods of diagnosis and our knowledge of pathology tell us very definitely that we have to do with changes that are permanent and are no more capable of being influenced by our treatment than is a hair that has turned gray. The habit still persists in the practice of many otologists of assuming that the progress of the deafness may be checked by local treatment, whether this deafness be the result of degeneration of the eighth nerve, primary fixation of the stapes or the chronic adhesive middle ear processes. Our knowledge of the pathology of these diseases has long since made it quite clear that this assumption is quite unwarranted.

I cannot end this paper without calling attention to the persistence of a popular fallacy regarding chronic suppurative otitis media. There is a wide chasm between the old view that a chronic discharge from the ear was nature's method of ridding the system of poisonous substances and that the checking of the discharge was fraught with imminent danger of serious complications and the more recent view that all cases of chronic discharge from the ear which cannot be checked by local treatment in a reasonable period are cases where

radical surgical measures are called for. Both of these views are fallacious. The former, no doubt, had its origin in the phenomenon observed occasionally when a cessation of a purulent discharge from the ear was promptly followed by the development of symptoms of a fatal intracranial complication. We know now that the cessation of the discharge in such cases is the result of a perforation of the middle ear disease into the cranial cavity and the beginning of a fatal complication. The other fallacy that all cases of chronic discharging ears are a serious menace to the individual dates from the time when it became recognized that cases of brain abscess, as well as many other fatal intracranial complications, such as meningitis and sinus thrombosis, frequently develop from the intracranial extension of chronic middle ear suppuration, even in cases where the ear disease was causing no local symptoms aside from the discharge and a depression of hearing. As a matter of fact, most of the cases of chronic discharging ears are not a serious menace to the patient in the sense that they may lead to an intracranial complication. It is only those cases of chronic suppuration where the process has extended beyond the mucous membrane lining the middle ear cavities to the underlying bone that the probability of an intracranial complication exists. It is, therefore, only these cases where radical surgical treatment is called for. With the knowledge which we now possess regarding the symptoms in the two types of chronic suppurative otitis media, we have, as a rule, little difficulty in differentiating the dangerous from the non-dangerous cases: in other words, those cases which call for radical surgical measures and those where local treatment alone is to be used, even when such treatment fails to check entirely the discharge from the ear.

A more or less widespread fallacy has been the assumption that a persistence of moisture after the radical mastoid operation is an indication of the failure of this operation. This assumption is based on a false conception of the real indication for the radical mastoid operation. The indication for this operation is not for the cure of otorrhea but for the

elimination of a dangerous focus of infection which is invading the temporal bone and which may at any time lead to a serious, even fatal intracranial complication. The dangerous focus is located somewhere outside the confines of the tympanum, either in the attic, the aditus or the antrum. A radical mastoid which eradicates the bone invading process and leaves the attic, aditus and antrum dry, has accomplished the real purpose for which this operation was indicated. The presence, after the radical mastoid, of moisture which comes from the patulent Eustachian tube is not in any rational sense an indication that the operation has been a failure.

Discussion.

Dr. Mac Cuen Smith of Philadelphia said that Dr. Shambaugh had pointed out several practices which were useless. If the patient had free nasal respiration and the tonsils and adenoids were not diseased; other nasal operations were of little use in improving hearing. Determination of hypertrophic rhinitis with ear symptoms was a simple matter. It was reasonable to presume there was a similar condition involving the tube. In an atrophic condition with enlargement of the cavity, inflation was useless. In regard to determining when a radical mastoid should be done, if there was a foul-smelling discharge, with destruction of the drum and ossicles it would not get well without a radical mastoid.

Roughly speaking, aural changes could be determined by an examination of the nasal chambers. If the patient was suffering from a hypertrophic rhinitis, it was reasonable to assume that the same condition involved the organ of hearing. On the other hand, if atrophic changes had taken place in the nasal chambers, the corresponding condition would be found in the ears, including, of course, the Eustachian tubes. In the latter type of cases, if inflation was ever used, it should be with caution. He seldom found it necessary to use a catheter as a means of inflation, but did use it when necessary to apply medication to the tube and middle-ear cavity. Inflation by means of Politzer's method was made very effective by first

placing a few drops of chloroform in the bag, then having the patient inflate the cheeks and at the same time causing a succession of air waves to enter the tube by frequent, short pressure on the bag, without releasing the pressure at any time. This procedure would inflate practically every case unless there was an actual structure. If one ear was to be inflated, the head should be placed to the opposite side, with the good ear tightly closed. This would enable one, in most cases, to inflate the affected ear, with little or no air entering the opposite side.

Dr. B. A. Randall of Philadelphia asked Dr. Shambaugh to enlighten them as to fibrous stapes fixation.

Dr. Shambaugh replied that there should be no difficulty in recognizing the typical form of otosclerosis, unless there has been present some alterations in the drum membrane, due to some previous middle-ear disease. He believes that there are a great many more cases of otosclerosis than is usually suspected. As a matter of fact, however, he would not be inclined to quarrel with Dr. Randall upon the use of the term otosclerosis. If Dr. Randall prefers to use the term fibrous fixation of the stapes, or whatnot, the fundamental fact remains that the progress and outlook of these cases are essentially the same; they are not influenced by local treatment and there is a chronic progressive deterioration going on; in some cases resulting in profound deafness; in other cases constituting only a moderate handicap.

Dr. T. J. Harris of New York asked if he meant otosclerosis when he said fixation of stapes.

Dr. Shambaugh said yes.

Dr. J. E. Logan, Kansas City, said that this paper was well worth while if it pointed out the habit of getting into a routine of office work, reducing the practitioner to an automaton and lessening his efficiency for his patient. Oper-

ations on the nose had very little effect on disturbances of the middle ear. Interference with ventilation of the nasal cavity should be removed, and it was important in cases of progressive deafness to eliminate hypertrophic changes in the pharynx and fossa of Rosenmueller and everything that would cause demobilization of the tensor tympani. With fixation of the stapes air pressure in the middle ear was impossible. Obstruction round the Eustachian tube must be removed. These muscles were attached in the tube. Dilatation with bougies accomplished nothing. In the fossa of Rosenmueller there were often vegetations restricting the action of the tensor and levator palati and tensor tympani, attached in close proximity.

Dr. C. W. Richardson, Washington, D. C., said that some points were very well taken, but some were doubtful. With regard to obstructive lesions and deformities of the septum, there was too much interference with the septum when it did not produce anatomic change. Many men operated on a spur and got nothing out of the operation. In regard to the ear, too little attention was paid to the general health of the patient and the condition of the gastro-intestinal tract. Hypertrophic catarrhs would improve when the digestive tract disturbances were cleared up. The ears would then get better without any treatment whatever. Excessive nasopharyngeal surgery was bad surgery and often resulted in cicatricial adhesions in the pharynx which was irremediable. He had examined many cases carefully and had found no thickened tissue in the fossa of Rosenmueller.

Dr. T. J. Harris of New York said that during the presidency of Dr. Richardson at the Triological, he had read a paper on the lines of that of Dr. Shambaugh. He then made a plea for the scientific treatment of the Eustachian tube and the abandonment of the indiscriminate use of the catheter. His experience had not been that of the last speaker. He had repeatedly found adhesions and remains of lymphoid tissue in the fossa of Rosenmueller. He felt

that the naso-pharyngoscope was not used as much as it should be in determining these adhesions and it should be used for examination of the fossa. One would learn a great deal more. The catheter as a routine procedure was unnecessary. Cases would not be cured unless one went to the root of the trouble. If the trouble were systemic, it must be treated; if from the sinus it must be treated. Discriminate treatment, not indiscriminate, would bring the best results.

Dr. Goldsmith, Toronto, said he thanked the members for allowing him to take part in the discussion. He would like to know how they would account for the cases of atrophic rhinitis and ozena without deafness, if one must exclude cases in which there was obstructive deafness or beginning of otosclerosis. This common association did not seem to be properly appreciated. Another question was did inflation improve hearing. One had to take into account the psychology of the patient. These patients had had all sorts of treatment and nothing had benefitted them. If one can assure them that they will never be totally deaf, it would give them hope and courage; one could get them to listen a little bit better and to pay more attention and get better results in their every day life.

Dr. B. A. Randall of Philadelphia said that to him middle ear inflation was an essential. He asked his patients to observe not so much the degree of improvement as the duration of improvement and the increase of duration. If the improvement continued, one was on the right path. If it did not continue, it was time to rest from the inflations. He included the cases where there was a diagnosis of otosclerosis. With catarrhal deafness and otosclerosis combined he could get results. The cases were uphill work, but the progress was real to the patient. Fatigue was a real problem; they were worn out with the efforts they had made. One should encourage forced attention if hearing was to be maintained. The tooth-marked tongue was one way to determine this fatigue. The bands in the fossa of

Rosenmueller should be looked for whether with the mirror or the pharyngoscope. He believed in application of astringents and heat to the nasopharynx, as most readily done by hot gargling.

Dr. George E. Shambaugh, in closing discussion, said that the idea of the benefit derived from inflation of the middle ear came from the experiences in treating cases of acute and sub-acute tubal catarrh. It was assumed that this treatment was applicable to cases of progressive deafness as well, especially in cases of chronic middle-ear catarrh, as distinguished from genuine otosclerosis. Inflation of the middle ear was of benefit only at those times when the patient was suffering from an acute exacerbation, when secretion was filling the tympanum. It is not scientific to rely upon the patient's own feelings in this matter. The patient is usually very fearful that he is going to be totally deaf and is very likely to imagine improvement in hearing under any treatment one can institute. We see patients with otosclerosis, for example, who for periods are elated over osteopathic treatment or treatment applied by the electrical charlatans. The psychology is the same when the otologists treat these ears by middle ear inflation. With our present methods of diagnosis, I think one is rarely left in doubt as to whether he is dealing with a process that may be improved by treatment and one where he can be absolutely certain that the changes in the ear are permanent and treatment of no use. This is true of the otosclerotic cases. How much better it is for the patient to be told definitely that the condition is not one that would be improved by treatment than to have him continue until he gets tired of such treatments. Our usefulness to these cases is in sparing them the necessity of undergoing a useless course of treatment, and at the same time we should see to it that they get the proper advice regarding the advisability of taking up lip-reading.

The Politzer method of inflation is as useful as any other in most cases. The fact that both ears were inflated did no harm.

In regard to chronic suppurative otitis media the differentiation of the dangerous from the non-dangerous type does not present the formidable difficulty which it did a few years ago. I would call attention to a few fundamental points in this differentiation. In the first place the mere continuation of a discharge is not in itself an indication of a serious menace. The key to the differential diagnosis is the question of whether the inflammation involves only the mucous membrane or whether it is a bone-invading process. If we keep this fact in mind, we have, as a rule, very little difficulty in differentiating the dangerous from the non-dangerous type. For example the dangerous type, that is the bone-invading disease, is either in the form of a caries or a cholesteatoma. Neither of these conditions are especially difficult to diagnose. In both there is present an offensive odor, which cannot be eradicated by local cleansing antiseptic treatments. In both of these conditions the perforation in the drum membrane is marginal, occupying, as a rule, the upper posterior quadrant of Shrapnell's membrane. The presence of a cholesteatoma is recognized by the characteristic whitish flakes. The discharge from a case of caries differs distinctly from that coming from an ear with involvement of the mucous membrane only. The characteristics of this difference are too well known to require special emphasis.

SOME OF THE MORE IMPORTANT MEASUREMENTS OF PARTS OF THE TEMPORAL BONE.

By EMIL AMBERG, M. D., Detroit, Mich.

In their article, Iatro Mathematics, George Dreyer and E. W. Ainley Walker (Contribution to Medical and Biological Research, dedicated to Sir William Osler, 1919, Vol. 1, p. 47) quote Stephen Hales (1727) who said:

"Since we are assured that the All Wise Creator has observed the most exact proportions of number, weight and measure in the make of all things, the most likely way to get any insight into the nature of those parts of the creation which come within our observation must, in all reason, be to number, weigh and measure. And we have much encouragement to pursue this method of searching into the nature of things from the great success that has attended any attempts of this kind."

An immense amount of data is found in many publications, e.g. in Schwalbe's Textbook of the Anatomy of the Ear in Jankau's Pocketbook for Ear, Nose and Throat Physicians,—a much more thorough and extensive review than I am able to give, and from which I quote very liberally. My object is to mention only very few of the more important measurements referring to the anatomy.

1. *Outer Ear Canal*:

Politzer gives the following data:

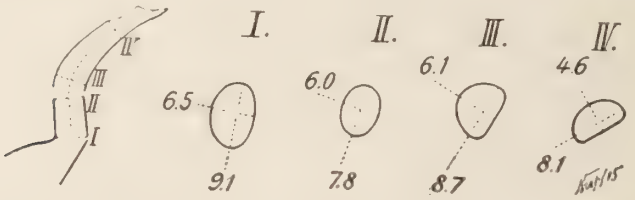
Length of upper wall	21 mm.
Length of lower wall	26 mm.
Length of posterior wall ...	22 mm.
Length of anterior wall	27 mm.

The length of the external auditory canal in the child, according to Symington (Internat. Zentral-Blatt f. Ohrenheilkunde 1907, p. 113: Jankau l. c. p. 80) is:

Age	Floor	Roof
2 months	17 mm.	13 mm.
6 months	19 mm.	14 mm.
1 year	20 mm.	15 mm.
2 years	22 mm.	16 mm.
5 years	23 mm.	17 mm.
6 years	24 mm.	17 mm.

According to Bezold (Schwartze's Textbook, page 7), the diameters of the ear canal are as follows:

	Large Diameter.	Small Diameter
Beginning of cartilaginous canal	9.0 mm.	6.5
End of cartilaginous canal	7.7 mm.	5.9
Beginning of osseous canal	8.6 mm.	6.7
End of the osseous canal	8.1 mm.	4.6
Drum membrane	11.0 mm.	9.0 (Schwalbe)



Section through the meatus perpendicular to its axis.
I at the entrance, *II* at the end of the cartilaginous part, *III* at the beginning of the bony part *IV* at the end of the bony part. (Bezold II, page 37).

Fig. 1.

Politzer mentions them as being:

At the porus acusticus externus	12 mm.	10.
In the middle of the osseous canal	9 mm.	5.
At the inner end of the osseous canal	10 mm.	4.

Hummel (Jankau l. c. page 79) gives the average capacity of the external meatus on the right side as 1.07, on the left side 1.05 cubic centimeters. The thickness of the skin in the cartilaginous portion is 1-2 mm. The thickness of the skin on the posterior wall is 0.5 mm.

2. *Drum membrane*:

Schwalbe (Textbook of the Anatomy of the Ear, part edition of the author's Textbook of the Anatomy of the Organs of Sense, 1887) gives minute measurements of many parts of the ear. He mentions that the drum membrane reaches its maximum almost at birth.

The dimensions, according to von Troeltsch, are as follows:

11 weeks, height of the drum membrane 2 mm., width 1¼ mm.
14 weeks, height of the drum membrane 3 mm., width 2 mm.
16 weeks, height of the drum membrane 4½ mm., width 3 mm.
20 weeks, height of the drum membrane 7 mm., width 5½ mm.
22 weeks, height of the drum membrane 8 mm., width 7 mm.
24 weeks, height of the drum membrane 8½ mm., width 8 mm.
7 months, height of the drum membrane 9 mm., width 8 mm.
8 months, height of the drum membrane 8½ mm., width 8 mm.
9 months, height of the drum membrane 9¾ mm., width 8½ mm.

Schwalbe claims for the apparent decrease in the eight month individual differences.

The thickness of the drum membrane, according to Henle (Jankau l.c. p. 80) is 0.1 mm., the size of the surface 69¼ square mm.

According to Schwalbe (l. c. page 451) the thickness of the stria malleolaris is much greater than that of the transparent portion of the membrana tensa. In the stria malleolaris it is 0.4 mm., while in thinnest spots it is 0.1—0.16 mm.

The epidermis of the drum membrane according to Schwalbe (page 452) is 40/1,000 mm. thick and consists of several epithelial layers; the layer immediately adjacent to the connective tissue consists of cylinder cells, then follow 5-6 layers polyedric cells rich in albumen and at last 3-4 layers of flat squamous cornified cells, which easily scale, but which are distinguished from ordinary cornified cells by possessing nuclei. The cutis of the drum membrane in its transparent portion is thinner than the epithelial covering, only 16-20/1,000 mm.

3. *Tympanic Cavity, including the epitympanic cavity*:

According to Schwalbe (l.c. page 466) the height of the tympanic cavity is the greatest at the posterior end. It is 15 mm. of which 6 belong to the recessus and 9 to the tympanum proprium. The greatest height of the latter is 10-11 mm. (Bezold 10.5-13 mm.). The height of the anterior wall to the entrance of the Eustachian tube is 4 mm. Schwalbe adds the practical consideration that a considerable quantity of fluid can aggregate in the tympanic cavity before the level is reached by which it might be evacuated through natural channels. The sagittal diameter of the tympanic cavity, measured from the lower portion of the entrance of the Eustachian tube to the posterior margin of the entrance of the recessus, is about 13 mm. (Bezold 11-14.75 mm).

The anterior wall of the tympanic cavity (page 464) is formed in its upper half by the tympanic ostium of the Eustachian tube, which is 3.5 mm. high (Bezold 4.5 mm. average, maximum 6 mm., minimum 3 mm.)

According to v. Troeltsch, the distance from the umbo to the most prominent point of the promontory is 2 mm. The lower portion of the drum membrane does not reach the floor of the tympanic cavity, the distance from the same is, according to Bezold, 2.71 mm. (average).

The lower space of the cavity (Jankau l.c. p. 80) lies 7 mm. medial from the upper, the anterior margin 4.5 mm. from the posterior.

Politzer (Jankau l. c. p. 80) gives the distance of the posterior inner drum segment from the inner tympanic wall as 5-7 mm., in the anterior upper quadrant, 5-6 mm., in the lower 4-5 mm.

4. *Ossicles.*

Time and space forbid lengthy quotations pertaining to the ossicles. I only mention (Jankau l. c. p. 82) that the average weight of the hammer and anvil are greater in the male than in the female, whereas the reverse holds good in regard to the stapes. I am not prepared to state whether this fact has any practical bearing on the prevalence of the consequences

of otosclerosis in the female. In connection with this idea it is interesting to note Wittmaack's statements.

Wittmaack (The Normal and Pathologic Pneumatization of the Temporal Bone Inclusive of Its Relations to Middle Ear Suppurations, Jena 1898, p. 293) says that the especially great degrees of hardness of hearing are preponderatingly caused by stapes-fixation just as much in residues of chronic middle ear suppuration as in chronic adhesive processes, and he further states that the development of "Otosclerosis" results independently of the pathologic pneumatization. He found it also in absolutely normally pneumatized temporal bones.

5. *Eustachian Tube.*

The Eustachian tube is (Jankau l.c. p. 80) 37-38 (to 45 mm.) long, and the osseous part about 8 mm., the cartilaginous about 25-27 mm. long. The tympanic end is 5 mm. high and 3 mm. wide; the pharyngeal 7 mm. high and 5 mm. wide and the isthmus 2 mm. high and 1 mm. wide.

6. *Mastoid Antrum.*

Bezold, in Schwartze's Textbook, page 32, says that the antrum is 9-15 mm. long, 6-10 mm. high, 5-8.5 mm. deep.

According to Whiting (The Modern Mastoid Operation, page 145), the antrum lies within the area of the suprameatal triangle and in 95 per cent. of all mastoids is to be found at an angle of 45 degrees (or thereabouts) upward and backward from the bony meatus at a depth of from one-half (½″) to three-quarters (¾″) of an inch beneath the cortex. When not so situated it will be encountered nearer the vertical meridian and further forward, and in certain instances has been found arching over the superior wall of the bony meatus only slightly external of the epitympanic space, with which it communicates by way of the aditus.

Schwalbe, page 525, says: "A horizontal plane through the suprameatal spine is always situated above the floor of the antrum. The insertion of the auricle lies 14/16 mm. behind the suprameatal spine." I may add, incidentally, that this fact can be quoted to advantage by those who advocate the

line of incision for a mastoid operation directly behind the auricle.

Bezold (Schwartze's Textbook, page 33) says that the drilling hole which starts below the crista temporalis and close behind the outer ear canal must be directed obliquely upward and forward in order to reach the antrum. The difference in height between the two points is 6-8 mm., the depth of the canal is 12-14 mm.

Jankau mentions the length of the aditus ad antrum as 4.5 mm. and its height as 5.7 mm. at the posterior end of the short process of the anvil, and the width as 6.6 mm. under the tegmen (Bezold).

7. *Mastoid Process.*

Kiesselbach (Schwalbe, page 527), carried out a large number of measurements concerning the growth of the mastoid process from the first month to the nineteenth year. At the end of the first year the height of the process had grown from 7.6 mm. to 15.5 mm., in the fifth year it had reached 20 mm., and in the eighteenth year 30 mm. Bezold (Schwalbe, p. 527) studied a hundred temporal bones of adults and found the distance from the tip of the mastoid process to a horizontal line through the suprameatal spine to be 25.2 mm. (varying from 19-31 mm.), the width of the horizontal distance from the middle of the tympano-mastoid fissure to the posterior end of the incisura mastoidea averaged 25 mm. (varying from 17-34 mm.). The mastoid process of negroes is as a rule smaller than that of Europeans, that of Mongolians larger (Schwalbe and Eysell).

The distance from the suprameatal spine to the facial canal, according to Hartmann (Jankau l.c. page 83) is 15.8 mm., to the semicircular canal 16.7 mm., to the posterior upper margin of the drum membrane 11-12 mm.

According to Holmes (Jacobson Textbook of Otology, 1898, p. 280), the distance of the upper posterior margin of the drum membrane from the suprameatal spine is, as a rule, 15 mm.

Hartmann (Die Freilegung des Kuppelraumes: The anatomical relations which must be considered in opening the

mastoid process concerning the possibility to injure the facial nerve and the labyrinth, Berlin, 1890) found in fifty specimens the distance from the suprameatal spine to the facial canal, eighteen times 15 mm. and less, twice 12 mm., twice 13 mm., and the distance from the suprameatal spine to the external semicircular canal eight times 15 mm. and less, and five times 14 mm.

He found the distance from the seat of operation, 1 cm. behind the suprameatal spine, to the facial canal ten times 20 mm. and less, four times 18 mm., and the distance to the outer semicircular canal eleven times 20 mm. and less, three times 18 mm. (no average measurements can be given, because in the specimens the most lateral portion of the facial and semicircular canals were not always encountered.)

Therefore, Hartmann says, one finds that one may encounter the facial or semicircular canal in a depth of 12-14 mm. from the suprameatal spine, or in a depth of 18 mm. from the seat of operation.

I present a few instruments made according to these measurements.

A probe, in the shape of a bayonet, bent twice at a right angle, of which the end-piece is 15 mm. long, may render good service during a mastoid operation (see figure 2), while another probe bent in the form of a hook, of which the middle portion is 15 mm. long, may also be useful (see figure 3). The No. 5 Reiner gouge chisel marked 15 mm. from the end may be welcome at times.

8. *Lateral Sinus.*

The location of the lateral sinus, as is well known, varies considerably. The distance from the suprameatal spine to the nearest portion of the sinus may be practically negligible (see specimen, E. Amberg: The Relative Frequency of a Protruding Lateral Sinus; N. Y. Med. Jour. and Phil. Med. Jour., Sept. 9, 1905). In seventeen other specimens, picked at random, I found it varying from 6 mm. to 21 mm. (Some Practical Remarks on the Anatomy of the Temporal Bone, with demonstrations, The Physician and Surgeon, Nov., 1899.)

Hartmann (Third International Otol. Congress, Basel, 1885, pp. 4 and 5) found the shortest distance between the sigmoid fossa and the posterior wall of the meatus in cross-cuts perpendicular to the axis of the meatus among one hundred temporal bones to be: forty-one times 1 cm. and less, once

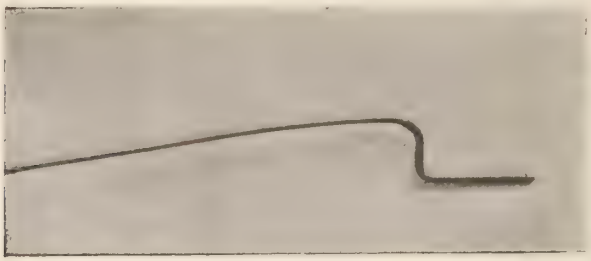


Fig. 2.

5 mm., five times 6 mm., six times 7 mm. The average distance was 11.5 mm., the greatest 19 mm.

Schœnemann (Basel, 1906)—Georg & Co., Temporal Bone and Base of Cranium (Jankau l.c. 1909, page 86) says: In pronounced flat-roofed pyramids which are not rotated backwards, the distance of the sinus from the posterior wall

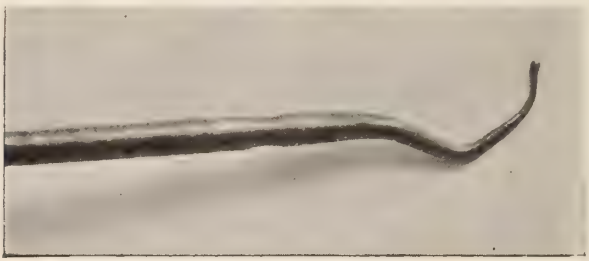


Fig. 3.

of the meatus is very great, maximally 1.6 cm., in pronounced sharp angle-roofed pyramids very small, minimally 0.7 cm. If the auricle stands pretty well upright, we need not fear a protruding sinus.

E. Amberg, Journal of Ophthalmology and Otolaryngology, July, 1917, says: The distance of the antrum mastoideum from the meatus is, after Bezold, 2 mm. or less. Schwartze

says that the mastoid has to be opened, as a rule, 5 to 10 mm. behind the spina suprameatum, and that the width of the outer opening might be 12 mm. After these measurements I made

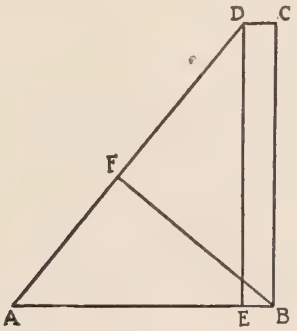


Fig. 4.

a diagram in the following way: (Figure 4) I constructed a trapezium with a right angle, one side of which, B C, represents the distance from the posterior wall of the meatus antrum, 15 mm. (after Holmes), the top of which, D C, represents the distance from th eposterior wall of the meatus

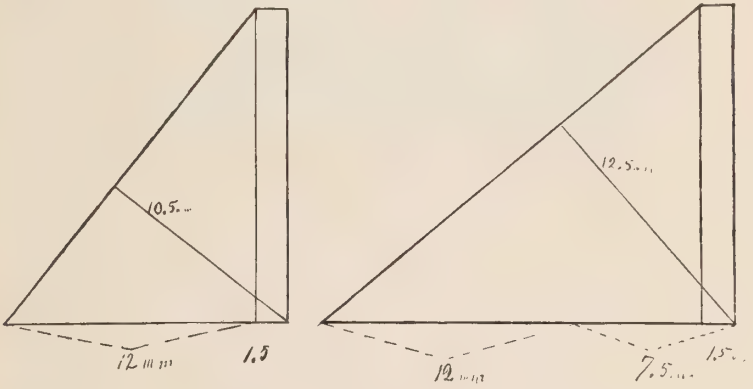


Fig. 5.

to the margin, one and five-tenths mm. (after Bezold, 2 mm. and less), and the base of which represents the distance of the anterior border of the opening E from the anterior border of the posterior wall of the meatus B, for

which distance, E B, I allowed one and five-tenths mm., which allowance can certainly not be considered as too liberal. For the second part of the base, E A, I allowed twelve mm., the largest diameter, according to Schwartze. If we connect A and D and draw the perpendicular from B on A D, we find that this perpendicular, B F, has the length of about ten and a half mm. I do not think we go much out of the way when we regard a lateral sinus displaced forward if it approaches the suprameatal spine more than ten and a half mm."

If we allow for B E *seven and one-half mm.*, F B is about twelve and one-half mm. (Figure 5) and if we allow for E A ten mm., F B is about twelve mm. The latter distance corresponds to that of Held.

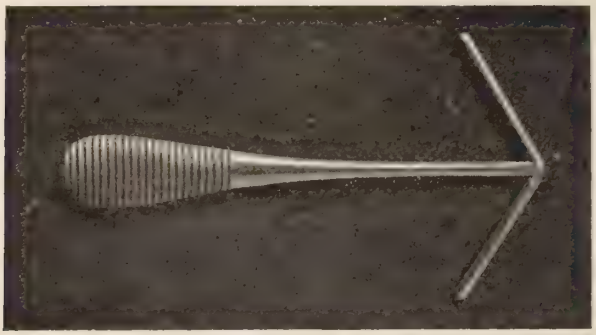


Fig. 6.

In this connection I may add that the finding of the lateral sinus has been made easier for me by applying the method described by me in the Journal of the American Medical Association of May 19, 1906. I called attention to the fact that in adults an easily accessible portion of the lateral sinus may be found when we open that part of the mastoid process which is located in the direction of the line which divides into two halves the angle formed by the temporal line and the anterior border of the mastoid process (an angle of about 115° in adults). In the Medical Record, October 22, 1910, I published a guide for the lateral sinus line for adults. (See figure 6).

One shank should be held over the anterior border of the mastoid process, the other over the temporal line. (See figures 7, 8). The handle of the guide gives the direction of the lateral sinus line. Even if the angle formed by the anterior border of the mastoid process and the temporal line should be somewhat different, the instrument is of service

Fig. 7.

by allowing the same margin of deviation to both shanks. The length of the whole instrument is about 8.25 cm.

9. *Labyrinth.*

Jankau gives the contents of the labyrinth as 210 cubic millimeters, 3/5 of which belong to the cochlea.

Schwalbe (l.c.) says that the length of the semicircular canals vary a great deal, that the posterior lower is always the longest, 18 mm. (average) (15-22 mm. Sappey), then follows the anterior (superior) with 15 mm. (12-20 mm.), the external is the shortest, 12 mm. The proportions of the lengths are 6—5—4. The ampullae are 2.5-3 mm. long and included in the measurements mentioned before. The size

of the crosscut of the semicircular canals, which is elliptic, is 1.2—1.7 mm. to 0.8-1 mm.

The cochlea (Schwalbe, l. c.) is about 10 mm. at its base, the distance from the base to the tip is 5 mm., the length of the canal of the osseous cochlea is about 33-34 mm., of which about 20 mm. belong to the vestibular portion and the first turn, 10 to the second, and 3-4 to the third half turn. The

Fig. 8.

number of Corti's cells is 20,400 according to Waldeyer, and 16,000 according to Hensen (Jankau l.c. p. 85).

The chords of the basilar membrane increase in length toward the tip of the cochlea from 1/20 to ½ mm. (Boeninghaus, Textbook of Otology, 1908, p. 61).

10. *Meatus Acusticus Internus.*

The length of the anterior wall of the inner meatus is 13—14 mm., the length of the posterior wall is only 6—7 mm. (Schwalbe, p. 301).

Conclusion.

Dry as the quotations of so many numbers and measurements may be, they may throw some light on the subject-matter from an angle not frequently considered. In practice, in consultation and while teaching, it may be necessary to use some of these measurements. We must always bear in mind that energy, once spent, is no longer available. Any consideration or procedure which enables us to conserve energy should be welcome as an aid to protect us against unnecessary fatigue. As a spectator, when an aurist endeavored to find the way to the lateral sinus in a mastoid operation, I could make it easier for him to succeed by a simple suggestion. (The lateral sinus line). Another aurist of experience, during a somewhat unusual mastoid operation, was embarrassed while he was trying to find the antrum. I was able to give him the well known direction, which probably did not occur to him at that moment, namely, to follow a line parallel to the meatus on the upper posterior wall of the same. (Politzer).

Only yesterday Dr. Reik told us of a surgeon who spent an hour to find the antrum.

It is, of course, impossible to make a mastoid operation fool-proof, if I may be permitted to use this expression. Nevertheless, any help which we may extend toward the more easy performance of any operation must be welcome, if only for the reason as stated before, that hereby a certain amount of energy is saved which can be utilized otherwise. Considerations of this nature are interesting and important subjects from a psycho-physical standpoint. (E. Amberg, Some Psychological Factors in Medical Work, American Medicine, Vol. 8, p. 302-305.)

Dr. Amberg showed some paracentesis knives which he had ordered made of stellite. He prefers them to the ordinary knives.

Discussion.

Dr. M. A. Goldstein of St. Louis said it had always been his impression that the annulus tympanicus was full grown at the seventh month of fetal life. Why should there be variations in the drum membrane?

Dr. H. B. Blackwell said that the advantage of stellite was that it did not lose its temperature when submitted to the highest heating. Boiling had no effect on the edge of the stellite knife. Stellite was a combination of chromium, tungsten and cobalt, discovered three years ago, and could be heated to 1800 F. It was used to cut other steels.

Dr. Shambaugh pointed out that the linea temporalis was not always a reliable land-mark for operations upon the antrum. This linea temporalis sometimes dipped down so as to intercept the middle of the external auditory meatus. An effort to enter the antrum below the linea temporalis in such a case would not be successful. In other cases the linea temporalis took a short turn upwards and here, if one used the linea temporalis as the land-mark for entering the antrum, the opening would lead into the middle brain fossa.

Dr. B. A. Randall, Philadelphia, said that Dr. Amberg's paper was very valuable and he will study its details with interest. Dr. Shambaugh might think him captious if he spoke of the relation of the antrum to other parts of the tympanum, of which it is the upper back portion, its floor always as high as the roof of the external canal. If anyone looked for the antrum where Dr. Shambaugh showed it in his blackboard drawing, he would be apt to miss it. In regard to measurements, in some cases the sinus was very close to the spine, even dehiscent there.

Dr. John Barnhill of Indianapolis said that Dr. Amberg's paper was valuable, in that it taught the operator to be on

the look out for anomalous conditions. One should learn to use the chisel so as not to hurt the sinus. The antrum was very high in the infant.

Dr. B. A. Randall, Philadelphia, said that the floor of the antrum was on the level of the roof of the outer canal. Following this line would give the position of the antrum.

Closing the discussion on his paper, Dr. Emil Amberg of Detroit admitted that the cranial fossa might be below the temporal line; that happened in a certain percentage of cases, and protrusion of the lateral sinus in about 5 per cent. Every surgeon should be prepared, when doing a radical mastoid operation, to do a Stacke operation. This is more difficult and one must have good illumination.

INTERNAL DRAINAGE OF ACUTE EARS; AND ABORTION OF ACUTE MASTOIDITIS BY THE USE OF SIR ALMROTH WRIGHT'S SOLUTION.

By GEORGE A. LELAND, A. M., M. D., F. A. C. S., Boston, Mass.

Drainage of the middle ear is furnished by nature through the Eustachian tube. This tube is not an open pipe but merely a slit in the side of the nasopharynx leading up to the bony isthmus, the posterior and superior walls of which are formed by cartilage, and inferiorly and anteriorly by soft fibrous (fascia) tissue. In hardened specimens at the top there appears to be a small opening which may be the lumen of a very small part of the structure, which in normal conditions may be more or less open. In very early life the direction of the Eustachian tube is nearly horizontal, assuming a more and more oblique downward direction as life advances. Now the tube is not simply a pipe to allow the passage of fluids either way, but is lined with mucous membrane whose surface cells are ciliated, the direction of whose constant motion is towards the pharynx.

Moreover, the position of the tube and the downward moving ciliae are not the only factors which assist drainage from the middle ear. The tensor palati which might be called the dilator of the tube as it is continuous with Rudinger's dilator tubae has its attachment to the anterior lip of the Eustachian cartilage and the fascia of the anterior wall and by its action pulls the whole anterior wall of the tube forward; and the levator palati is attached inferiorly to a part of the lateral plate and to the membranous part of the floor of the tube. By their contractions these muscles exert a pumping action on the pharyngeal end of the tube with every movement of the velum as in talking, swallowing, etc. This is very prettily shown by the late Dr. Holmes' nasopharyngoscope. Through this little instru-

ment may be seen the forward pull of the anterior wall of the Eustachian tube and also a bulge under the mouth so as to wedge it open. This swelling is described (Quain) as the belly of the levator of the palate. At all events this pumping action is very well seen to open the tube by the tensor palati and the bulging belly of the levator to push the anterior wall forward and the posterior harder wall somewhat backward. And it may also be seen that if the inner part of the mouth (pharyngeal orifice) is obscured by thickened membrane or if it is covered by translucent adenoidal tissue or if the fossa of Rosenmueller is narrowed or obliterated by adhesions or adenoidal masses, this pumping action is much curtailed or abolished.

It is probably true that 95-99% of acute middle ears have their origin in inflammatory conditions of the nasopharynx, the consequent swelling blocking the Eustachian mouths. I have laid myself open to criticism by saying that, except from trauma, 100% of the children under 12 years of age with acute ears have adenoids. By this I do not mean masses of adenoids sufficient to block respiration but sufficient to diminish or inhibit drainage and ventilation through the Eustachian tubes; and by this is meant sufficient adenoids to prevent this pumping action and to hinder free exit of whatever the ciliated epithelia may bring down.

Hence as nature has supplied this mechanism for this purpose, it has long seemed rational to re-establish these functions when by inflammatory thickening, infection or simply by hyperemia they are held in abeyance.

Some years ago at an A. M. A. meeting* a reader or speaker mentioned that Leland did not hesitate to operate on adenoids in acute conditions. For years it has seemed to me that this is just the right time to operate, especially for acute conditions involving the middle ear, for then the great desideratum is drainage, *cito, tuto et jucunde.* It

*The Relation of the Rhinopharynx to the Middle Ear and Mastoid by E. L. Jones, M. D., Cumberland, Md. Jour. A. M. A. Jan. 9, 1915. Vol. LXIV, pp. 115-117.

may be readily seen that a quick restoration of the above mentioned functions is the best way to bring about drainage; and it especially recommends itself because there is then no way for infection from without as in the classic operation of paracentesis, after which an acute case frequently requires attention from one to six weeks with danger of the middle ear becoming purulent, and of infection of the external canal.

The method is simply to clear the region around the Eustachian tube in front and below, but especially in the fossa of Rosenmueller. This evidently cannot be done with any form of a nasopharyngeal guillotine, because that instrument does not reach the fossae; but must be done with a nasopharyngeal curette of almost any form, or with the sharpened sterile and alcohol-hardened finger-nail. In using the curette, the contour of the spinal column should be borne in mind, and then with the shank of the instrument in the same side of the mouth with an outward twist and downward sweep, the posterior wall of the fossa is readily and smoothly cleared; the finger-nail may then be used to finish up (the *tactus eruditus*). This procedure is usually followed up by a little belladonna or atropia to diminish circulation in the throat. Usually, when the earache is thus treated early, within the first twenty-four to forty-eight hours, the inflammation in the tympanum immediately subsides. But even after three or four days, if rupture of the membrana tympani has not taken place, drainage begins, bulging subsides, and soon the hyperemia disappears.

With all these acute attacks, it is probable that there is more or less effusion into the tympanum. Hence, after the redness has disappeared, say after five days, it is good practice to blow the drumhead away from the inner wall to prevent adhesions. This may be necessary but a few times, for it is probable that the drumhead soon assumes its normal position, because air finds its way into the drum cavity. After five days or so, it may also assist to make a few applications of an organic silver disinfecting and

astringent solution to the sides of the nasopharynx especially into the wounded fossae lest adhesions again diminish their width and depth.

Brief mention of a few cases may point this moral if they do not adorn the tale. About seven years ago on a Tuesday, a child of about three years of age, her face suffused with an acute cold was being hurried away from the clinic. The mother said she had cried with earache two or three nights. Both drumheads were red and markedly bulging. Over a cuspidor two rooms away from the mother, vociferous lachrymation and futile resistence being at this age a good analgesic, with the sharpened and cleansed finger-nail the nasopharynx and especially the lateral recesses were relieved of masses of soft adenoids, accompanied by much hemorrhage—a good derivative—which soon ceased. Two days later there was no bulging and there had been no more pain complained of; slept well. Two days later the redness had almost disappeared and the child appeared to the mother about normal. In this case the duration of the earache before treatment had been longer than desirable.

On Nov. 26, 1913, about 7 P. M., I learned from a pediatrician, that a child was in need of a specialist, for acute ears. I found a child of seven months, both drumheads bulging, on one of which was a considerable bleb. The child, of course had taken cold; had not slept much the night before, peevish all day, without appetite, in fact, had refused food. I told the doctor that I did not wish to incise the drumheads as that probably would mean more or less attendance afterwards, but I preferred to get internal drainage. He said he did not know what that meant, but what I wished to do he would sanction. We therefore enveloped the child in a blanket and sheet and without anesthesia, with Vogel's small curette, the nasopharynx and especially the fossae were freed from a small amount of adenoidal tissue. It was impossible to get my finger up behind the palate. I therefore used the curette to scrape and roughen the surface as much as possible. Hemorrhage slight. Prescribed a small amount of

belladonna to be given when awake through the night. I asked the doctor to make his visit in the morning and to call me if he found things not satisfactory. He found the child sitting on her mother's knee crying for a second bottle; had been a little restless the early part of the night, but had slept pretty well; no sign of inflammation in either ear. The bleb had broken, but the drumheads were in good position and color; there was no injection to be seen. He expressed astonishment at the condition of the child. I took the precaution to examine her next day. Found the condition of the ears as if nothing had taken place. On the fifth day I called to inflate the middle ears and found her out-of-doors in her carriage, a blustering December day. I also visited the child next day and inflated the ears and that was the end of the trouble—otitis media acuta, 24 hours standing; immediate restoration to the normal.

On Jan. 30, 1916, a gentleman in a neighboring city said his family doctor wished to incise one of the drumheads in his little girl of about three years of age, but he preferred to have it done by a specialist. I found the right ear markedly bulging and reddened. This was the ear that was to be cut and the other ear was just beginning; therefore, if the right had been cut it would have been necessary in a few hours to perform the same service for the other. After a slight argument, the doctor who expressed ignorance of any such procedure, persuaded the father to allow the adenoid operation. This was done as usual with special reference to the region of the tubes behind and below. It was accomplished with a curette, and finger-nail. The doctor afterwards said there was no sign of inflammation next day and the ears were inflated on the fifth day. I afterwards learned from the father that the family physician was doing the same thing to some of his patients with success.

On the 7th of April, 1915, a child about $2\frac{1}{2}$ years of age had complained of an earache two or three days. About the same conditions as above mentioned were found, and the same treatment was carried out. The subsidence of symptoms and restoration to normal conditions did not take place

for about nine days and then inflation was necessary twice within a week. Since that time no trouble with the ear has taken place, and she has been remarkably free from colds.

These cases are not the only ones, of course, but are perhaps typical. Whenever an acute middle ear (and also ordinary catarrhal cases) come into my practice this is the treatment followed, if the parents and patients can only be persuaded to allow it.

Of course in the light of modern carelessness as to ears, which happily is gradually disappearing, this operation may seem too formidable to parents; therefore we sometimes meet with opposition. This procedure, moreover, while it has brilliant results in the acute cases is also beneficial for conditions of the middle ears where a chronic process, catarrhal adhesive, or suppurative seems intractable. It is doubtless true there would be many less running ears and many less cases of catarrhal deafness if the restoration of the free Eustachian tube with an efficient pumping action of its muscles could be restored.

Now as to cases of abortion of mastoiditis, here drainage comes into play again, and it is time the profession woke up to the futility of trying to drain abscesses through a pin hole, as my colleague, Dr. Borden, has expressed it. It has been my practice for the last six or eight years to drain acute inflammatory conditions of the middle ear involving the mastoid through multiple openings of the membrana tympani and the peripheral walls of the canal. Dr. George P. Sanborn, a pupil of Sir Almroth Wright and our best serotherapeutist, introduced me to Wright's so-called "drawing" solution." Sir Almroth describes its action as making use of a decalcifying substance (Sodium Citrate) which stops coagulation of the blood together with an hypertonic solution of salt which induces rapid exosmosis.* "The Citrate of Soda by decalcifying the lymph, prevents coagulation and scabbing; and the Salt, acting by osmosis, causes fluid to transude from the blood vessels. Under the influence of this application a clear lymph wells out and the local conditions rapidly improve." The solution consists of 1%

*From "Studies on Immunization," p. 355.

Citrate of Soda and 4% Salt, (Choride of Sodium). An acute mastoid usually shows tenderness and redness and perhaps some swelling over the bone. In this case there is usually a much thickened and reddened drumhead and marked prolapse of the walls of the bony canal especially superiorly and posteriorly. A small hole through the drumhead usually does very little good, therefore an incision should be made through the posterior segment of the drumhead curving upward and backward on the bony wall of the canal and cutting deep down to the bone. Three other deep incisions are made similarly through Shrapnell's membrane beginning at the posterior fold, upward and out on the canal; another at the anterior fold, another directly above the neck of the hammer. Of course the bleeding is profuse. Sometimes coagulation of the blood will stop sufficient drainage. In order to obviate this, the solution of Citrate and Salt is poured in warm immediately after the incision and with a pledget of cotton in forceps or with a cotton-applicator is pumped down into the depth of the canal and the bleeding encouraged and clots wiped away if any until the solution is well applied to the incisions. A light gauze wick is then introduced, saturated with the solution, and a dry pad (or two) placed over the orifice. The pad is to be changed as often as wet, but not the wick in the canal. Usually the cotton pad is soaked as often as every 15 minutes in the next 24 to 48 hours and it is often astonishing how much serum comes away. The next morning the wick in the canal is changed and the warm solution again poured in; and if the incisions have begun to close they are wiped with a cotton-applicator to start bleeding again. This latter procedure I have found almost never necessary.

Now this flux is not simply drainage, but we get the advantage of a tremendous welling outwards of a large amount of lymph with its more or less bactericidal action, which power increases as more and more fresh serum is drawn from the blood and washed through the infected region. At any

rate inflammatory conditions of the mastoid are usually absent in the course of a day or two.

Feb. 18, 1914. With a Chesterfieldian flourish a physician of Jamaica Plain brought me a patient, saying "Ah! Dr., I have brought you a mastoid." Man 29 years old, large, florid and well-fed, five weeks before had a cold. Four weeks ago much pain in left ear. Paracentesis at a hospital two weeks ago. Five days before visit X-rays showed mastoid cloudy. Feverish and chilly up to two weeks ago. Treated by external heat and whiskey. At visit temperature 100° F. Pus in canal, drumhead red, thick, opaque, granulations and a pouting perforation upper posterior quadrant. Tenderness over antrum and posterior border of tip, no swelling nor redness over mastoid. Nasopharynx treated with solution of silver nitrate 4% and Rhinitis full strength every hour till dry throat. Nose much engorged with marked deflection of septum to left.

19th. No pain since yesterday; tenderness over antrum, but not at tip. Took rhinitis tablet triturates too few.

Two days later, 21st—pain began at noon on 20th and lasted till 6 A. M., today tenderness and slight edema on mastoid. Membrana tympani thick, red, bulging. Free paracentesis under local anesthesia. No pus, some blood, soaked in Citrate of Soda and Salt solution. Bloody serum discharged all night. Cotton pads changed often, much pain 9 P. M. to 1 A. M. At visit bloody wick removed, serous discharge. Soaked again with same solution; corrosive wick and cotton pads.

No pain night of 22nd. Much discharge till 10 A. M. Tenderness nearly disappeared.

On 25th, seven days after first visit, no pain for three days, no granulations, pouting perforation absent. Feels well. Two months later hearing about normal. This case which had trouble four weeks with temperature, cleared up in about five days without mastoid operation, which seemed satisfactory.

Feb. 2, 1916, a suburban physician 'phoned in he was sending me a mastoid case, and he wanted nothing to do with it.

Rev. F. H. S., 39 years old, had grippy cold three days. General pain, malaise; yet preached three days before. On the 1st inst. 3 A. M. very severe pain in right ear, broke at 10 A. M. Copious bloody discharge since: at visit 12 M. pain nearly gone. This A. M. considerable tenderness of mastoid. Holds head bent to right. No digastric pain. A. M. temperature 99.8 . Right ear otitis media acuta with perforation, brown exudate on upper posterior wall; posterior wall and Shrapnell's membrane prolapsed; granular surface under exudate.

At 1.30, under ether, posterior segment incised, and Shrapnell's in three places all out onto and through to bony wall of canal. Wright's solution pumped in, corrosive wick wet in this solution and gauze pad to auricle. Rx rhinitis ½ strength every hour.

That night rather restless, very copious watery discharge. Evening temperature 100.5°. Pulse 96. Considerable tenderness of tip and hurt to open mouth (tenderness of inner surface of tip). Wick and solution and pads renewed.

Feb. 4, discharge less, pads changed less often. Tenderness of tip continued. Evening temperature 99.4°.

5th. Less swelling of membrana tympani and Shrapnell's; less tender tip. Evening temperature 97.4°.

6th. Better, less discharge, mastoid tip and digastric tender. Posterior inferior quadrant slightly swelled; paracent, under local anesthesia, slight bloody flow, same solution used (citrate sodium and salt). Went to complete recovery and on the 28th hearing normal. Membrana tympani shows scar in posterior segment and bright point of adhesion at anterior border of umbo.

It was, I think, McKernon who called attention to prolapse of superior and posterior walls in grippy conditions, after the great influenza epidemic of 1889 and 1890. This case with that bony involvement and tender tip seemed bound for a mastoid, but subsided in five or six days.

Aug. 3, 1918, F. S., boy 10 years old, brought by mother from beach. Great swimmer. Night of 29th ult. (5 days before) much earache. Probably got sea water (dilute

sewage) into nose and blew it, as is seen so commonly at bathing places, salt and fresh. Next two days treated at home with hot instillations and hot boric irrigations. Next day more comfortable. Today, lanquid, no appetite, less pain last night than at first. Head held stiffly to right. Temperature 100.3°. No pain referred to mastoid. Drumhead bulging, red and thick, especially Shrapnell's and posterior segment. Anterior and posterior tip tender.

As an elder brother had had a mastoid operation 5½ years before, parents were much afraid of having another. Hence under primary ether, usual four deep incisions made. Cit., Soda and Salt solution pumped in many times as blood clotted very quickly. Few adenoids were stripped from sides of nasopharynx with curette and finger-nail and grain ⅛ Belladonna Extract given every hour. Pads changed frequently that night and next day, no pain, ear tender, temperature 99.8° at noon. Moved from hospital to hotel on 5th. Temperature normal on 8th (5 days); and on 22nd, nineteen days after, no discharge and hearing about normal.

This case seems to have taken considerable time—19 days —but my experience with these cases of infection by sea water, (or nasal irrigating solutions) has been such that nineteen days doesn't seem long. Here the value of the transudation of lymph by Wright's solution, which may be considered a chemical Bier's method of passive congestion, is well demonstrated.

Let us not forget also the advantages of clearing out the sides of the nasopharynx, so as to restore ventilation and drainage thro' the Eustachian tubes.

It may be thought that the duration of treatment of these cases does not indicate any advantage over a simple paracentesis. Of course it is a common experience to cut a bulging drumhead and to have the inflammation subside in a few days; but it must be borne in mind that in cases above mentioned, on account of prolapse of the walls and more or less temperature and tenderness at the tip of the bone, a mastoid operation seemed very likely in the near future, espe-

cially in cases where the inflammatory thickening of the membrana tympani and mucosa of the middle ears was so great as to result in a nipple perforation which is of almost no value as to drainage. One of my late colleagues once said he disliked to see nipple perforations because they were *always fatal*. That may have been so thirty or more years ago but in these modern days when the mastoid operation is resorted to with much less provocation, if drainage cannot be obtained through the middle ear, it can be through the bone. But by use of Wright's solution and free incisions, it can be accomplished in almost every instance if not delayed too long, i. e., until much pus has formed. Here it has not done so well. And there is a further, and probably the most important advantage in getting at these cases as early as possible, and that is to stop inflammatory deposit which means hardness of hearing sooner or later.

Discussion.

Dr. B. A. Randall, Philadelphia, said that glycerin had a hygroscopic action. He thought that by combining phenol 10% in glycerin with atropin, in contact with the drum head, you could get better unloading.

THE EDUCATION OF THE VESTIBULAR SENSE.

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This study is restricted entirely to physiology. For the sake of clearness, certain definitions should first be made. The vestibular apparatus is defined as including the vestibular portion of the internal ears, the intracranial pathways from this portion of the internal ears, and the brain centers. The term, vestibular sense, is restricted to the function of this apparatus. The vestibular sense is one thing, "deep-sense" another thing, eye-sense another, and touch another.

Each organism has developed its own special sensory equipment to meet the particular needs of its life and environment. In order to avoid catastrophe and hazard in coming in contact with the external world, one of the first requisites of animal life is the sensing of motion. The lowest forms of animal life, like the coral, come into existence, live and die without changing position. As motion is no part of its life, the coral has no need for motion-sensing. Higher in the developmental scale, animal life is freed from an anchored existence and is tossed about upon the ocean bed by the waves; motion becomes a natural part of its life-destiny and motion-sensing becomes a requisite. The primitive otic cup develops to fill this need; and sensory hairs are acted upon by water and sand particles. The amphibious animal, during its land excursions, becomes exposed to *air*-borne wave shocks of greater delicacy and of more or less regular wave-length. These cannot be sensed by the already developed motion-sensing apparatus and in response to this new need develops a primitive cochlea. In animals living in fluid media the need of motion-sensing is naturally greater; some fishes develop upon their surfaces additional sense-organs, for enabling them to sense all motion accurately and in-

stinctively—the so-called linear endogans. Thus their equipment includes visual sense, vestibular sense, deep-sense and "visual-line" sense. Similarly, in birds the semicircular canals are developed to a relatively enormous extent in response to their particular necessity for full and instinctive possession of adequate knowledge concerning motion.

The blank cerebral cortex of the *baby* begins to receive messages from his special senses. That is the beginning; the end result is the fully developed child with normal equilibration. What are the steps of this development?

The human infant is endowed at birth with only four known sensory gifts which he may utilize for motion-perception: vision, "deep-sense," touch, and vestibular sense. These constitute the means of his acquiring information and experience with respect to motion; upon the proper use of such sensory information depends his further development of certain motor abilities. When he first attempts to sit up, the force of gravity pulls him over and he bumps his head, thereby encountering pain, perhaps for the first time. As he is being pulled over by gravity he sees he is falling, he experiences a sensation of falling coming from his deep-sense, and that coming from his ears. With repeated experiences of this sort, his memory gradually stores up the knowledge that, given this deep-sense, visual and vestibular testimony, pain (the bump) is inevitable. His developing mentality commences to interpret these sensory impulses which tell him he is beginning to fall; appropriate motor coordination begins to develop and then become evident attempts to check the fall. Eventually he becomes able to sit up without falling. Still later, in the same way, he becomes able to stand, then to walk, then to run.

Whereas sight, deep-sense and touch contribute to the general detection of motion, yet, for critical requirement, it was apparently necessary for *all animals that move about* to possess, in addition, an organ whose sole function is the sensing of motion. To fill this need, nature developed within the human bony cranium a single physical apparatus—the

vestibular portion of the internal ear. Just as the eyeball is the prototype of the camera, and the tympanum the prototype of the telephone, so this apparatus is the prototype of the seismoscope. The eyeball is devised for only one physical operation—the focusing of light waves; the tympanum, with its vibrating drumheads and ossicular chain, is devised for only one physical operation—the transmission of sound waves; just so the semicircular canals and the saccule and utricle with their fluid content bathing erect hairs, make up an instrument devised for only one physical operation—the detection of motion in every direction. The impulses from this motion-sensing organ, integrated in the sensorium with those from all other sensory sources, go to make up the individual's composite motion-perception. To what degree each one of the special senses contributes to perfect motion-sensing is not known; we do know, however, that the absence of any one of these elements impairs full motion perception. Observation shows that the equilibration of any individual who lacks one of the three main fundamentals to motion-sensing is below that of the normal. For example, the individual lacking vestibular sense, or the tabetic lacking deep-sense, cannot stand on one foot with closed eyes. The reason for this inability is that his motion-sensing composite is inadequate for necessary motor coordination; *beginning motion* of the fall is not sensed with sufficient speed and delicacy to permit him to make necessary motor adjustment in time to prevent the continuation of the fall. The normal "catches himself" before the falling becomes evident.

Studies of the vestibular sense are comparatively so new that it might be well to attempt to state what we do and do not know at the present time, concerning the semicircular canals and their intracranial connections. When we all went to medical school the course in physiology included several weeks on the eye, several weeks on the organ of hearing, and considerable time on the study of the other special senses. Is it not rather striking to remember that

all we heard in our physiology course was a casual mention, somewhat as follows: "The semicircular canals are situated posterior to the cochlea, and are 'concerned with equilibrium.' We will now take up the study of the heart."

Why was the vestibular sense overlooked through so many years? Perhaps because motion-sensing is not so obtrusive in our every-day life as are sight, hearing, smell, or taste—those senses which minister to our pleasure or displeasure. Pleasant and unpleasant sights, beautiful music and harsh noises, agreeable and disagreeable odors, and the taste of good food or bad—these things obtrude themselves upon our notice; the perfect sensing of motion does not attract our attention. Here all the time was a good servitor who did not make his presence felt.

Another very practical reason for our comparative ignorance of the vestibular apparatus is that there were no technical methods devised for testing or studying this mechanism until the comparatively recent introduction of the turning, caloric and galvanic tests, whereas for a long time we have had the means at hand to test and examine the other sense-organs.

In spite of the present limitations of our knowledge, is it not, however, a fact that there are certain things which, even now, we know to be true and accurate about this apparatus? We have a clear knowledge of the microscopic anatomy of the internal ear, due particularly to the work of the Vienna School and G. E. Shambaugh, and the physics (or mechanics) of the semicircular canals has been made clear. Further, it would seem that the following 14 points are fairly established.

1. This end-organ is developed phylogenetically and embryologically second of all—preceded only by touch.

2. The horizontal canals may functionate independently, whereas the vertical canals—the superior and the posterior—always act together for a mechanical reason—because of the existence of a common crus.

3. The horizontal canal is connected with the third and sixth nuclei. The obvious proof is that stimulation of the normal horizontal canal always produces a horizontal pull of the eyes.

4. The vertical canals are connected with the third and fourth nuclei. Proof: Turning or caloric stimulation of the vertical canals produces vertical or rotary—but never a lateral—movement of the eyes.

5. The horizontal canal fibres and the vertical canals fibres have separate and distinct intracranial pathways after the eighth nerve enters the brain-stem*.

6. Impulses producing nystagmus follow different nerve-paths from those producing vertigo.

7. Stimulation of the ears produces only the slow pull of nystagmus, not the quick jerk.

8. The eyes are always pulled in the direction and plane of the endolymph movement.

9. In the normal, stimulation of any canal causes a sensation of motion.

10. This sensation of motion, vertigo, is always in the exact plane of the endolymph movement and in a direction opposite to the endolymph movement.

11. Past-pointing is not a "Reaktion"—(Barany): It is a voluntary attempt to locate the external object at a point where it is not. Both past-pointing and falling are expressions of a sensation of motion.

12. The normal duration of after-turning nystagmus is 24 seconds.

13. Normal responses to ear stimulation determine definitely that the Vestibular Apparatus is intact.

14. Failure of normal responses to ear-stimulation is definite evidence of some abnormality of the Vestibular Apparatus.

Having up to this point discussed the physiology of Motion-sensing, and having emphasized that the Vestibular Sense is only one of the four senses concerned, we might now take up examples of education in Motion-sensing. In

*Pages 122 to 128, book "Equilibrium and Vertigo."

this connection we might well ask ourselves, what is known about aviation, otologically, that we did not know three years ago? We know:

1. An individual can become an excellent flier without being perfectly normal physically. As Glen Curtis put it, "Anybody who can ride a bicycle can fly an airplane." The "mystery" that surrounded aviation in the early days is now cleared up. Flying is a much simpler matter than we had thought.

2. While everyone *can* fly, safety demands that not everyone *should* fly. War experience has taught the other countries the necessity of raising their original standards of physical requirements. The man with good heart, lungs and kidneys, normal sight, normal vestibular sense and stable nervous system is a far safer pilot than the man laboring under the handicap of any physical deficiency.

3. We now know that no set of tests or special examinations yet devised in any country can *prophesy* whether any given individual will become a good flier or not. This demonstrates the wisdom of the U. S. Air Service in never attempting any such prophesy. So many have considered that tests were useful only as they "correllated with flying ability." It can not be done. The requirements of our Service were the securing of a normal individual; this increased the factor of safety and made more sure that the flier's future usefulness would not be impaired by discoverable physical defect.

4. We now know that the ear plays a far greater role in flying than we originally suspected at this meeting three years ago. It is well enough to have a normal ear, but we have found that the *brain must be trained* to interpret the unusual impulses coming from the internal ear in aerial acrobatics. Many crashes and deaths are directly traceable to this lack of education in interpreting the ear stimuli. We have learned that it is possible to educate the Vestibular Sense and also the visual and deep-sense through actual aerial acrobatics; or more safely, by a course of training in

an Orientator. It must be further noted that an acquired education of the Vestibular Sense may be lost or partly impaired through disease. Hence a perfectly normal and trained flier may, through fatigue, toxemia or what not, become unfit for flying. Dangers from this source can be prevented by frequent re-examinations.

Taking up each of these points in further detail.

1. We now know that one-eyed men, men with noticeably impaired semicircular canal function, one-legged men—all *may* make good fliers; the immortal Guynemer accomplished his best work while dying from consumption—he had hemorrhages from the lungs from time to time and then would return to active flying duty.

2. Medical men of different specialties in all countries were asked to study the physiology of flying and to attempt to devise a series of tests which would eliminate the possibly unfit from their respective Air Services. Vestibular Tests were made an important feature of the examination in every country. The Germans and Austrians required the caloric as well as the turning tests of the ear-mechanism; these tests were conducted by their most skilled labyrinthologists. The Italian Air Service work was under the direction of Gradenigo; special turning-chairs were devised and a new method of making the pointing tests was used. The French used both the turning and caloric tests and employed specially constructed turning-chairs. Belgian labyrinthology is best represented by the electric turning-chair and nystagmograph of Buys of Brussels. The Canadians also routinely used the turning-chair and in doubtful cases used the caloric test, as we did.

The English, like all the others, felt it important to determine that the Vestibular mechanism was normal; their present point of view is perhaps best expressed by quoting "Reports of the Air Medical Investigation Committee on The Sense of Stability and balance in the Air." Dr. Henry Head, chairman of the Investigation Committee, gives the following conclusions (p. 43).

General Summary.

"1. Conscious stability and comfort in the air depend primarily on the normal response of three groups of sense-organs. These are the vestibular apparatus, the eyes, including the eye muscles, and the proprio-ceptive system with its endings in muscles, tendons and joints * * * We are interested in those impressions which lead to recognition of the position of the body in space.

"2. Defective responses from any one of these afferent end-organs will disturb the sense of equilibrium in the air, and may lead to actions that affect the stability of the machine.

"3. No candidate for service in the Royal Air Force is accepted who shows gross abnormality of any one of these primary organs of sensation."

This expresses in a very clear way the exact viewpoint of the United States Air Service, also. During the war, however, the English method of determining "Vestibular Stability" did not include the turning or caloric tests: on reviewing the otologic work of the English, Dr. Head states —" 'Vestibular Stability' is estimated by the power to walk along a line, to turn on one foot and to stand on one leg with the eyes closed. But there is no evidence to show that any of these acts bears a direct relation to the activity of the semicircular canals. Moreover, I have examined four pilots who were intensely giddy and vomited in the air, none of whom had the least difficulty in carrying out these tests perfectly. * * * There is nothing to show that inability to walk a line and to turn on one foot is evidence of anything more than clumsiness. * * * One Cadet found difficulty in walking heel to toe and turning on one foot. He ultimately became an excellent Scout Pilot, but confessed that he disliked dancing. In fact it seems to us that this test is more likely to show ability to dance than any capacity to fly. But whatever relation it may bear to flying it is certainly not evidence of 'Vestibular Stability'. * * *Of the ten who had been 'giddy' and vomited, nine reacted excessively to rota-

tion in the chair. * * * We can bear with impunity certain violent disturbances of equilibrium if the stimulus is expended on certain parts of the vestibular apparatus, but not if it falls on other combinations of the semicircular canals. * * * The majority of normal men do not suffer from these symptoms in the air. There are, however, some in whom the physiological response is so violent that it can never be overcome, and they are always giddy and nauseated whenever there is any sudden or considerable change in equilibrium. * * * The majority of these patients could not swing with comfort in childhood and habitually suffered from train sickness. When rotated on a chair the larger number were uncomfortable and suffered from nausea and sweating."

The American viewpoint is in entire accord with the findings and conclusions of Dr. Head, in that the English tests, just quoted by him, are not adequate; our Air Service has used in addition—from 1917—the turning and caloric tests to determine the function of the Vestibular Apparatus.

3. No one denies the wisdom of making every effort to choose normal men for flying; but what does constitute the normal? Visual, auditory and general physical standards were commonly recognized and established, but vestibular standards were not. The vestibular requirements set by our air service were that the average normal should show between 16 and 36 seconds of afterturning nystagmus.

At the time of the adoption of these standards it was recognized as a very difficult matter to state dogmatically what is the average length of nystagmus and past-pointing. All that could be relied upon were deductions from clinical experiments with a series of healthy individuals examined by various observers over a period covering ten years, as contrasted with the impaired responses observed in merely a few hundred pathologic cases. It was realized that it was a great responsibility to establish what should be regarded as normal responses. We therefore publish at this point the composite results of the turning-chair test performed by skilled standardized otologists in the examining units on

many tens of thousands of applicants for the aviation service. A compilation of statistics has been made, the digest of which, with respect to responses in nystagmus, past-pointing and falling, entirely confirms the standards originally set.

For detailed statistics, the reader is referred to the book, "Air Service Medical," published by the Division of Military Aeronautics, pages 83 to 94, inclusive. The average duration of nystagmus of the entire number examined and tabulated was, after turning to the right, 23.5 seconds; after turning to the left 23.2 seconds. The average number of past-pointings was between three and four past-pointings of each arm in each direction.

It is interesting to note that these figures are quite at variance with the findings of Barany, who stated that the average duration of nystagmus after turning to the right is 39 seconds and after turning to the left, 41 seconds. The first one to call attention to the inaccuracy of these findings was George McKenzie, of Philadelphia, who in 1917* corrected Barany's work and stated that 24 seconds is the normal response.

Of those rejected, 50% failed in the eye requirements, as compared with only 6% in the vestibular tests; and yet Dr. Henry Head states, "American workers have laid great stress on this response to rotation * * * in fact, this method of examination formed, at one time, the determining test for admission to their flying service." This statement of course is simply due to unfamiliarity with the official examination blank, (A. G. O., 609). This statement also infers that our point of view has altered; our standards are unchanged.

4. It is an idle task to speculate on the relative importance of each of the special senses to the aviator. They are all important. The need of a normal vestibular mechanism in motion-sensing, however, was illustrated by experi-

*Observations on After-Turning Nystagmus, by George W. Mackenzie, Philadelphia. Annals of Otology, Rhinology and Laryngology, June, 1917.

ments conducted with deaf-mutes on the flying field of Mineola, Long Island. These have demonstrated that individuals lacking vestibular function (deaf-mutes) when taken up in a plane blindfolded could not tell the character and nature of simple evolutions. Furthermore, when taken up repeatedly it was impossible for them to develop any proficiency in motion-sensing. These were checked by identical maneuvers with normals. These normals were able to detect these maneuvers much better than the deaf mutes on their first trial and further, with a few repetitions they quickly acquired more and more ability to detect these evolutions.

The one big asset to the flier is confidence. Until he has educated his vestibular sense he cannot have this confidence. Edward Rickenbacker states:

"I remember when I thought it was time to try a vrille or tail spin. I knew what I was supposed to do. I knew you put the stick over and crossed the controls, but I'd never seen anybody do it. I went up about 12,000 feet, got off some distance from the field, and flew around there for every bit of 30 minutes trying to get up my nerve to try the trick, but too scared to begin. At last I said to myself 'What's the matter with you? You've got to do this'", and threw the stick. She went into the spin all right, but I had her back to neutral after just one whirl and I tell you I was glad when she righted. Next day, I went out and it took 20 minutes to make up my mind to try again. It was only on the third day that I went at the job with any confidence and let her do a real spin.

"That is still more or less the way I feel about doing a new stunt, after all the flying I have done at the front since.

"When you try a new thing, you are never quite certain how the machine will behave, and though you may have confidence in your ability to get out of anything as long as you have the altitude, there is a sort of hesitation both in the machine and in you. The trouble is, you do not know what the strains will be on either."

Every aviator has gone through exactly the same experience; but little by little he becomes familiar with these queer sensations until, fully trained, right in the midst of a spinning nose dive or tight spiral, instead of wondering "Will I ever come out of this?" he is thinking, "I wonder where I mislaid those keys this morning?"—or some such trivial thought. Acrobatics becomes a matter of pleasure rather than of fear.

The Orientator is a new additional safeguard in aviation; it also provides a new method of vestibular studies. The inventor of this apparatus, William Guy Ruggles, has perfected a "turning chair" that will revolve in all conceivable planes about a central point. From a purely theoretic standpoint, he had the vision to conceive of an instrument that would permit an individual to do the "Otologic part" of flying before going into the air. Furthermore, this instrument is not merely otologic—it also trains the eye and all senses concerned in motion-sensing. This machine does not teach the pupil to fly, but does duplicate all the stimulations produced in spins, spirals, loops and all turning evolutions possible in the air. A very useful feature is that the Orientator produces much more violent and unusual turning sensations than can possibly be encountered in the airplane. In this way the pupil is safeguarded, by becoming familiar with sensations more intense that he can possibly encounter later in the air.

Many deaths and crashes in the future will be avoided by "orientating" the individual on the ground rather than by "throwing him into the air" to learn it.

From the purely otologic standpoint, this instrument is a great step in advance in the study of the physiology of the vestibular apparatus. From the ear standpoint, aviation has taught us what we could never have learned on the ground, by putting the human being in a fluid medium and subjecting him to twistings and turnings otherwise impossible. Medical experience in aviation has taught us that otologically, the ideal flier is one whose vestibular mechanism is sufficiently acute to detect motion keenly; even more im-

portant, that this mechanism shall not be hypersensitive, rendering it difficult for him to be comfortable and safe after turning evolutions; in other words, one who is within reasonable limits of the normal. Taking such an individual training him to become familiar with turning sensations by means of the Orientator, and then permitting him to undertake aerial acrobatics—this is the safe and sane method to begin "learning to fly."

What is the next step for future research? Fliers should be trained blindfolded, both in the Orientator and in the airplane. Sufficient study has already been made to indicate that in this way the flier becomes more and more keen in the sensing of motion as well as comfortable and efficient while flying at night or in a cloud. Robert J. Hunter* conducted such experiments as Flight Surgeon in the Air Service.

Quoting from Hunter, "Blind men were used in London, during the war, to help locate the Gothas. They could hear them quickly and detect the direction better than men with sight. Silk workers in India detect the slightest variation in thickness with great skill, through the development of their tactile sense. Tea and brandy tasters for the trade, have the sense of taste trained. Many here tonight recall the blind man who for years delivered provisions in the downtown section of this city. I remember well his queer call, and especially the wonderful accuracy with which he found his way through the street. His sense of direction was highly trained."

A new pilot will always dodge a cloud. In the days when protection was of such value in war flying, airplanes could easily hide in thick ground mist, clouds or "smoky horizons;" but it was an unpleasant experience for new men to try it. New to the sensation of having their feet taken from the ground and flying in the air, depending on their "motion-sensing" which had never been called upon to take up duties of this character, pilots, in self-defense, had to learn flying. This "something" seems to the practical flier to be

*Transactions of the Section of Otology of the College of Physicians of Philadelphia, May 21, 1919.

flying. This "something seems to the practical flier to be educating his motion-sensing. The eye, deep-sense and touch had to be educated in this new environment but it is to be noted that pilots in clouds become accustomed to cloud-flying and instead of avoiding clouds actually make for them; this indicates that some sort of adaptation has been made possible which makes the pilot comfortable after all his vision has been taken away. Pilots who have done a lot of cloud flying state that each time they enter a cloud it becomes less difficult to keep in a flying position.

This then is the next step, to train fliers blindfolded. The instructor can watch the progress of the pupil and it is reasonable to expect that sufficient instruction can be given in this manner so that a pilot may be assured of increasing ability to fly in clouds or in any condition in which his vision is restricted or entirely eliminated. In this way the education of the vestibular sense would not only familiarize the flier with vertigo sensations but will develop an increasing accuracy in sensing motion.

So much for aviation. Is it not remarkable—the extent to which education in motion-sensing can be carried? A man sits on a chair, the hind legs of which are placed upon a rope stretched across a space of thirty feet; he can sense each infinitesimally small motion so accurately that he is able to maintain equilibrium for an indefinite period. However, no matter how constantly a man might practice, he would always be laboring under a marked handicap if he does not possess all fundamental requisites for motion-sensing. Conversely, with full sensory equipment, it is astonishing how quickly an individual may become adept in the instantaneous correct motion-sensing so essential to any motor co-ordination requiring speed, delicacy and accuracy.

The education of the blind is accomplished by hyper-education of his other senses—and he is then able to live comfortably in spite of his blindness. The education of the deafmute consists of hyper-education of the other special senses. These individuals are able to compensate for their

misfortune by the hyper-education of the other senses which are normal. On the other hand an individual possessed of full motion-sensing acuity of vestibular sense, touch, deep-sense and eye-sense, can be hyper-educated. The ability to translate motion-sensing into motor co-ordination can be hyper-educated to a degree that will distinguish this individual from others who are also normal. This normal is then enabled to become—by intensive hyper-education, a tightrope walker, a trapeze equilibrist, a hotel waiter balancing a tray, a stunt flier, an expert in the Orientator, a whirling dancer, an acrobatic tumbler, an expert swimmer or an old "sea dog."

Perhaps the most common example of the education of the vestibular sense, with which all people are more or less familiar, is seen in overcoming sea-sickness. Sea-sickness is now recognized to be a phenomenon resulting from movement of the endolymph within the internal ear. All forms of motion—rotary, linear fore and aft, and linear up and down, are encountered on a ship in a storm at sea. Unfortunately to get used to the sea, we must go to sea. Every effort has been made by innumerable investigators to make life at sea more comfortable for a "land-lubber," only to find that, after all, the only cure for sea-sickness is the education of the vestibular sense.

Discussion.

Dr. B. A. Randall, Philadelphia, said he had had some influence in the War Department in regard to testing eyes and ears of aviators. There had been opposition at first to the ear tests by some who ignorantly supposed that they were displacing the equally important visual tests. The kinetic sense should be distinguished from equilibrium, which included efferent as well as afferent parts of the system. It was possible to do without some of the senses, but he questioned if Dr. Goldstein's deaf mutes could safely swim in the dark. They would be likely to drown. They would not know whether they were coming up or going down. It would be like

Mark Twain in the dative case in German. The value of education of the vestibular sense still needed careful investigation.

Dr. Amberg asked Dr. Jones, was it possible to educate an end organ? Dr. Jones said no; education was a cerebral function.

Dr. Amberg also said that education was not in the end organ, but in the brain which interpreted the impressions.

A monograph by de Vries, entitled "The Mechanism of Thinking", deals in a masterly manner with education in some of its aspects by the formation of pathways in the brain. Dr. Amberg said he was inclined to agree with Politzer's view, concerning the mechanism in educating the partially hard of hearing and considered it a purely cerebral function. He illustrated his view by the well-known example that one hears ones own name the best, when it is called out in a crowd, on account of the preformed and well-established pathways in the brain.

Dr. Goldstein said he had been working on the dead labyrinth; what form of education did he produce in a congenitally deaf child? Was the improvement in the end organ, or central?

Dr. Jones said Dr. Goldstein had perhaps done something to improve reception of impressions in the end-organ.

Dr. S. MacCuen Smith, Philadelphia, said that he knew of an expert silk buyer, absolutely color blind, who bought wonderful color combinations by means of some unexplained sense.

Dr. B. A. Randall, Philadelphia, said that in color blind people there was no perception of color, but of what artists called "Values" which was very difficult to teach to painters. Where the sense was sub-normal it could be educated.

Dr. Lewis Fisher of Philadelphia said that otologists were studying the ear with reference to aviation, but this was a side issue; the ear was an important physiological organ, which helped in sensing motion. It is of course not correct to consider the inner ear as an organ of equilibrium; equilibrium is the result of a composite series of impressions received by the brain, from several sources, such as the eyes, the sense of touch, and the semicircular canals. The brain translated these impressions into motor response. Movements originating within the body itself are sensed by the semicircular canals.

Mr. Ruggles, of New York, said that it had given him great pleasure to respond to the invitation of Dr. Harris to speak in regard to Dr. Jones' paper. The subject of equilibrium had interested him since childhood, and later he made experiments to test the effects of unusual positions on muscular co-ordination. He had made a search of the libraries to find the literature on the subject and to study the reports of medical investigators in this line. Mr. Ruggles then showed lantern slides illustrating the orientator, which worked with motion in three axes, and in which the aviators were trained to work blindfold. Tests were made with written sentences showing the disturbance of coordination in unusual positions. The effects of over coordination were shown, illustrating the fact that men would do things with their hands that they were not conscious of. Some of the candidates were unable to continue writing at all and were unable to explain why the lapse of control occurred.

Dr. J. G. Wilson, Chicago, said he confessed his inability to understand what Dr. Jones believed took place in this education of the vestibular sense. It is of course not uncommon to speak of the labyrinth as the sixth sense (the "vestibular sense"). One may not object to this broadening of the term sense, if one recognizes that the term when so used has not the same definite restrictions as has the same

term when given to the eye as the organ of sight or the cochlea as the organ of hearing. In sight and in hearing one has a distinct and a conscious sensation which is completely blotted out by destruction of the organ. No such conscious sensations and no such deprivation follows in the case of the otic labyrinth. It is a misnomer to speak of the vestibular sense as *the* balancing sense or *the* balancing mechanism. The otic labyrinth is not the balancing mechanism, it is but one of the afferent endings of the balancing mechanism. Unless one grasps this significance one loses sight of the various factors which are essential to equilibrium and of the coordinating mechanism which probably is the part where education, if one could speak of it as such, takes place. Again, there was a looseness in the expression vestibular system. What is the vestibular system? If it begins in the otic labyrinth, physiology has not yet told us where it ends, nor determined what constitutes it.

Dr. Jones remarks about the testing of aviators by the English medical authorities seems to be another point in which there is a lack of appreciation of what equilibrium implies. He complains that the ear tests were not sufficiently applied in testing English aviators. From personal knowledge Dr. Wilson knew that such tests were not neglected in the examination of aviators in the English army. When in England in 1916 a rotatory chair was in common use in the hospital to which he was attached. Without doubt the British medical authorities had a different view point in their testing from what was, or at any rate seemed to be, emphasized early in the war by American authorities. The British medical officers insisted that though the ear tests were important they were not all essential, that the eye was equally important and that due regard ought to be given to the motor reactions from various peripheral stimuli. Dr. Wilson felt that even Dr. Jones recognizes the importance of this point of view, more today than he did in the beginning of the war, and in that sense he has changed his view point in regard to the testing of aviators.

Dr. L. W. Dean, of Iowa City, asked if tests were made on dead labyrinths, and if so, what was the result?

Mr. Ruggles said that he had had very interesting experience with men who had got their training in flying, in the machine. They could perform any turns in the orientator, showing that the education of coordination was required. The man who had never been in the machine was totally unable to coordinate. An aptitude was shown almost immediately.

Dr. George E. Shambaugh, Chicago, said that he did not think it strictly correct to refer to the vestibular mechanism as one designed for sensing motion alone. His conception of the vestibular mechanism was one having two distinct functions; one of the functions of sensing motion, and the other the function of assisting in maintaining the body equilibrium. These two acted in conjunction with each other, but the maintainance of equilibrium was often accomplished without having anything to do with motion or sensing of motion. The equilibrium of the body is preserved normally by means of a constant stream of tonus impulses emanating from the labyrinth. Ewald was the first to make this fact quite clear. He believed that the tonus impulses emanating from the labyrinth owed their origin to a constant current of endolymph, resulting from the secretion of the endolymph in the region of the stria-vascularis and the escape of this endolymph constantly through the aquaductus vestibuli. This, of course, is based on a faulty conception of the anatomical facts. The endolymph which fills the membranous labyrinth does not join the cerebrospinal fluid, the membranous labyrinth being a closed sac. Barany found that the existence of tonus from the labyrinth was necessary to account for the phenomena, especially those resulting from an injury to one labyrinth. Barany believed that this tonus had its origin in tonus centres and that the tonus of these centres was replenished from impulses emanating from the labyrinth. What the origin of the labyrinth impulses was he did not attempt to state.

My own conception of the origin of labyrinth tonus is this: There is a constant stream of tonus impulses emanating from the hair-cells in the cristae of the semicircular canals. These impulses are dependent upon a constant stimulation of these hair-cells. The stimulation of the hair-cells is the result of movements in the endolymph. These movements in the endolymph, which produce tonus even when the body is quite still, owe their origin to pulsations similar to the intra-cranial pulsations, synchronous with the beat of the heart. The several openings from the labyrinth, the oval window, the round window, the aquaductis vestibuli, the aquaductus cochleae, all assist in permitting, with each pulsation of the heart which is transmitted to the labyrinthine vessels, a to and fro motion in the endolymph. When the body is suddenly deprived of the tonus impulses coming from one ear, there is a tremendous upset in equilibrium, with intense vertigo. Where this disturbance takes place simultaneously in the two ears, there is no vertigo; the disturbance in equilibrium is simply the result of an absence of a normal tonus to all skeletal muscles, which results in a weakness, rather than a real upsetting of equilibrium or balance.

Dr. Shambaugh has had the opportunity of observing two cases where, after one labyrinth had been totally destroyed for a number of years, there occurred a sudden destruction of the opposite labyrinth. In both of these cases there was an absence of the vertigo which follows the destruction of one ear, where the other remains normal.

The labyrinth is not the only source for tonus impulses to the skeletal muscles. All impulses from the periphery to the brain centre seem to be a source of extra labyrinthine tonus. Where both labyrinths are entirely destroyed these extra labyrinthine impulses develop so as to take the place in a large measure of labyrinthine tonus. But a person who has sustained a loss of both labyrinths, never has entirely normal equilibrium.

"THE EDUCATION OF THE VESTIBULAR SENSE,"

By WILLIAM GUY RUGGLES.

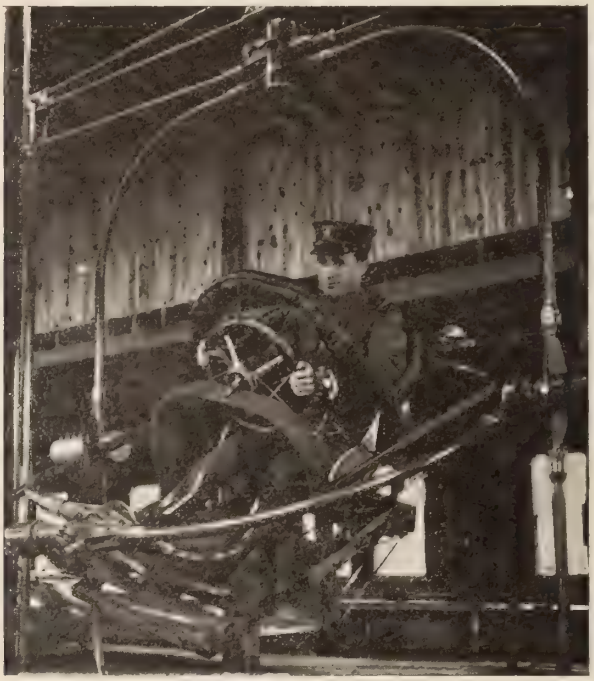
The subject of Dr. Jones's paper has fascinated me for years. I am convinced that the vestibular sense can be developed, trained and educated to an extraordinary degree.

The very brevity with which the vestibular functions were treated in my childhood studies was in itself sufficient to arouse my curiosity. Practical investigations became more interesting when the subject—myself—suffered a severe fall while studying the effect of unaccustomed positions upon muscular co-ordination.

Years later, when turning to the study of aviation, memory marshaled these bits of information, and search of the libraries disclosed the reports of research work done by amazing skilful medical investigators which demonstrated the vestibular sense of very vital importance to man in all his activities. While finding nothing in these reports treating this subject in relation to flying, they could be taken as confirmation of my own belief, that the labyrinthine, or vestibular functions, were of greater importance to man while flying than during the normal activities on the earth.

Any mention of the anatomical structures involved is superfluous before this body. The brain, voluntary and involuntary, a prisoner in a dark, bony castle, is automotive only by directing to its will a most amazingly intricate organism—the body—limp as a rope or rigid as a tree. To have knowledge of special relationship where starting from and how to reach a destination, the brain must secure information from outside the brain itself. The mechanism by which the brain gathers this information, compares, values, decides and starts muscular actions and then reconsiders and redirects when results are not as expected, is beautiful beyond the expressive power of language.

Information from all these sources arriving over different nerve pathways of different lengths is assimilated by voluntary or involuntary brain, or both, and the resulting deductions are the basis of muscular activities. If the brain fails to receive information from any of these sources, decision may be delayed or information may be insufficient for intelligent action. Very urgent nerve impulses from a sensory

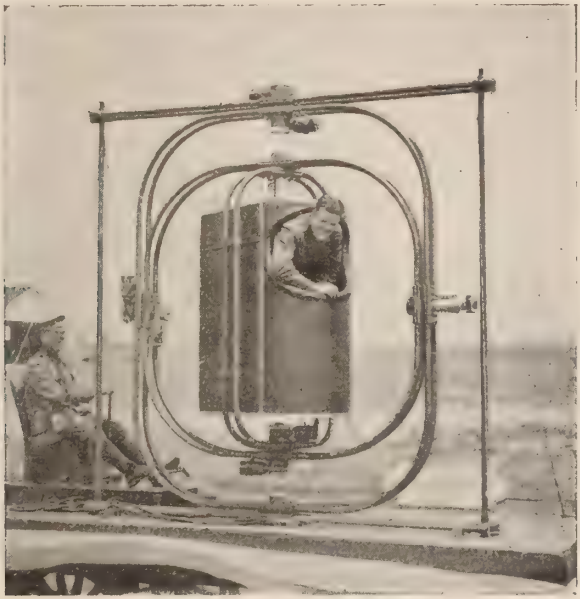


"Ruggles' Orientator" No. 1.
Installed at Massachusetts Institute of Technology, Cambridge, Mass.
Used by U. S. Naval Aviation Detachment.

field near the brain may cause a muscular action that is incorrect, and would be so indicated by a nerve impulse traveling from the extreme distance yet arriving too late to be of value before action was begun.

The major axis of the astronomical telescope rotatively mounted parallel to the axis of the earth, and may be geared to a suitable driving mechanism which, as the earth rotates

from West to East will turn the telescope from East to West with an even and equal rate of rotation. Thus the object under observation maintains the same position in the focal plane of the telescope. The semicircular canals of the labyrinth do just that for the eyes, not in one plane, however, but in *three* planes of direction. This comparison is of interest here for if the driving mechanism of the telescope were to vary the astronomer would have to decide whether the star had moved, the earth varied in rotation or the tele-



"Ruggles' Orientator" Model 4.

scope gone wrong. Just so when the semicircular canals are excessively stimulated the vision pictures become disorientated from the true line of gravitation and the other faculties must assist in establishing the point of error. A space of time is required to determine this and during which the muscle and tactile senses hold fast to the earth, the relative position of which is retained by memory and a semblance of equilibrium is maintained. When considering

and attempting to comprehend the physiological problems of flying this is one of the facts standing out prominently. The airplane is an unstable base.

The airplane in flight is capable of complete rotation in any direction. Man is not usually accustomed to such movements. If subjected to maneuvers of that nature the ability to co-ordinate smoothly the muscular actions required is generally lacking until education has progressed for a space. If unaccustomed rotations and positions are in

"Ruggles' Orientator" Model 4.

rapid succession the muscular action may, owing to the inability of the brain to assimilate such a flood of information, be entirely lacking or of a violent and unintelligent nature. The muscles may even become rigid.

While piloting an airplane the brain should be capable of correctly estimating spacial relationship from the unstable support and exact calm, but immediate and correctly co-ordinated muscular action, entirely apart from any tendency to involuntary and unintelligent reactions. These

nerves, mental, and physical powers taken together may be considered as a faculty. During the time the airplane is in the air in flight, this faculty is of greater importance than any other ability. Therefore I refer to this as the Fundamental Flying Faculty, for upon this, and this alone, the aviator must depend to direct and land his craft. Knowledge of mechanics, language, or politics will at that time avail him nothing. Either he flies or he doesn't.

"Ruggles' Orientator" Model 4.

This faculty can be educated—even without realizing what is happening exactly—by careful and extensive flying in the airplane, just as many children have learned to walk. The desire to minimize the time, expense, and hazard led to the invention of an apparatus to develop that faculty.

This apparatus was never intended "to teach you to fly on the ground" as so many have incorrectly stated, and does not do that. But its careful and proper use will develop and educate the vestibular sense to an extraordinary degree and the

muscular co-ordination in all possible positions. If properly applied its use will also develop the ability quickly to determine which of the false rotational sensations to counteract and appreciate the apparent uncertainty of vision picture information before stimulation has subsided.

A story of my efforts to have this idea and invention recognized before we entered the war does not belong to this discussion, but the use of this apparatus before the war ended—and since—has proven the education of the vestibular sense entirely practical.

To derive the largest measure of benefit from this educational work the machines should be outside where the student may accustom the brain to vision pictures of the horizon in all angles, and part of the work should be done blindfolded. Under such conditions, and with careful attention on the part of the instructor the involuntary aversion to flying can be very quickly eliminated.

Sensible, cautious persons of responsibilities do not attempt to eliminate any danger by denying its existence, but minimize an undeniable danger by thoroughly understanding its nature and cause, and safely guarding against it. This applies to crossing the street, riding on a train, climbing a tree, or eating our food. Giving the vestibular sense a universal education is just a sensible procedure for pilots and passengers, preliminary to flying.

Aviators in whom the labyrinthine sense and those associated powers that go to make up the Fundamental Flying Faculty, are developed and educated experience the confidence of performance in the sky of the trained skater on ice, or the musician at the piano, and become the involuntary brain and intuitive director of a magnificent physical and mechanical organization. Serene in this confidence the other senses, less occupied in flying, awaken and thrill to ecstasy as they attune themselves to the splendors of the situation. The mighty pipe organ notes of the droning motor with its aeolian accompaniment of singing wires; the glories of the scenic effects; the rushing flow of rejuvenating ozone—business cares become trivial.

With an abandon known only to eagles and gods they course the sky deeps of the air ocean at exhilarating velocities, darting through cool, fleecy clouds, and with magnificent distances on every side figuratively swing the earth through three dimensions.

Once the physiological problems involved in flying are thoroughly understood and comprehended by the masses, and the ease and comfort in which they may be scientifically developed and educated are made known, not only the adventurous will desire to fly. Thousands and hundreds of thousands will avail themselves of this incomparable means of pleasure and transport. Quantity production will then make possible a superior airplane at a moderate price.

Aviators' physical problems are essentially your responsibility. Aviation will force a new, interesting and very useful duty upon the otologist, who should immediately prepare to care for the requirements in this rapidly expanding art. Concerted effort will best serve the great worldwide flying fraternity of the future.

TRANSACTIONS

OF THE

AMERICAN OTOLOGICAL SOCIETY,

FIFTY-FOURTH ANNUAL MEETING.

HOTEL CHELSEA

ATLANTIC CITY

JUNE 1 and JUNE 2, 1921.

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1904—Dr. Richard Jordan.....165 West 58th St.....New York, N. Y.....
1921—Dr. J. C. Keeler.....Med. Arts Bldg.....Philadelphia, Pa.....
1907—Dr. B. R. Kennon.....201 Taylor Bldg.....Norfolk, Va.....
1910—Dr. Philip D. Kerrison.....58 West 56th St.....New York, N. Y.....
1898—Dr. John C. Lester.....616 Madison Ave.....New York, N. Y.....
1914—Dr. Eugene R. Lewis.....1920 Orange St. nr. West Lake. Los Angeles, Cal....
1895—Dr. Robert Lewis.....48 West 40th St.....New York, N. Y.....
1911—Dr. Hanau W. Loeb.....537 N. Grand Ave.....St. Louis, Mo.....
1904—Dr. James E. Logan.....1208 Wyandotte St.....Kansas City, Mo.....
1898—Dr. George B. McAuliffe....616 Madison Ave.....New York, N. Y.....
1910—Dr. James F. McCaw.....Bank & Loan Bldg.....Watertown, N. Y....
1897—Dr. James F. McKernon....62 West 52nd St.....New York, N. Y.....
1912—Dr. O. A. M. McKimmie....1330 Mass. Ave. N. W.....Washington, D. C....
1888—Dr. Henry L. Morse.....112 Marlborough St.....Boston, Mass.....
1911—Dr. Harris P. Mosher.....828 Beacon St.....Boston, Mass.....
1891—Dr. Robert C. Myles.....11 East 48th St.....New York, N. Y.....
1903—Dr. Francis R. Packard.....304 South 19th St.....Philadelphia, Pa.....
1913—Dr. John R. Page.....127 East 62nd St.....New York, N. Y.....
1913—Dr. Charles E. Perkins.....616 Madison Ave.....New York, N. Y.....
1903—Dr. Wendell C. Phillips....40 West 47th St.....New York, N. Y.....
1906—Dr. Norval H. Pierce.....22 E. Washington St.....Chicago, Ill. .....
1899—Dr. Edward M. Plummer...5 Adams St.....Charlestown, Mass...
1914—Dr. George H. Powers, Jr...298 Marlborough St.....Boston, Mass.....
1908—Dr. John B. Rae.....247 West 70th St.....New York, N. Y.....
1888—Dr. B. Alexander Randall...1717 Locust St.....Philadelphia, Pa.....
1901—Dr. Henry O. Reik.....City Club, 55 W. 44th St.....New York, N. Y.....
1906—Dr. W. Scott Renner.....341 Linwood Ave.....Buffalo, N. Y.....
1901—Dr. George L. Richards....124 Franklin St.....Fall River, Mass.....
1886—Dr. Huntington Richards.....Concord, N. H.....
1898—Dr. Charles W. Richardson.1317 Connecticut Ave.....Washington, D. C....
1909—Dr. Walter Roberts.....1732 Spruce St.....Philadelphia, Pa.....
1919—Dr. Charles M. Robertson...32 N. State St.....Chicago, Ill.....
1875—Dr. John D. Rushmore.....129 Montague St.....Brooklyn, N. Y.....
1915—Dr. W. E. Sauer.....201 Humboldt Bldg.....New York City.....
1912—Dr. T. Laurence Saunders..120 E. 61st St.....New York, N. Y.....
1904—Dr. George E. Shambaugh..People's Gas Bldg.....Chicago, Ill.....
1890—Dr. John B. Shapleigh.....Grand & Washington Aves....St. Louis, Mo.....
1906—Dr. Warren S. Shattuck....160 Clinton St.....Brooklyn, N. Y.....
1912—Dr. Burt R. Shurly.....32 Adams Ave. W.....Detroit, Mich.....
1906—Dr. E. Terry Smith.....36 Pearl St.....Hartford, Conn.....
1909—Dr. S. MacCuen Smith.....1429 Spruce St.....Philadelphia, Pa.....
1906—Dr. Sargent F. Snow.....707 University Block.....Syracuse, N. Y.....

1909—Dr. Selden Spencer	2725 Washington Ave	St. Louis, Mo.
1904—Dr. Franklin M. Stephens	19 West 54th St	New York, N. Y.
1910—Dr. Joseph A. Stucky	Fayette Nat'l. Life Bldg.	Lexington, Ky.
1914—Dr. Edward Blair Sutphen	162 South St	Morristown, N. J.
1886—Dr. Theron Y. Sutphen	999 Broad St	Newark, N. J.
1901—Dr. Lewis H. Taylor	82 South Franklin St	Wilkes Barre, Pa.
1912—Dr. J. J. Thomson	3 Park Ave	Mt. Vernon, N. Y.
1914—Dr. George L. Tobey	416 Marlborough St	Boston, Mass.
1906—Dr. Joseph A. White	200 East Franklin St	Richmond, Va.
1921—Dr. Leon E. White	390 Commonwealth Ave	Boston, Mass.
1906—Dr. Ernest de Wolfe Wales	1236 Pennsylvania St	Indianapolis, Ind.
1906—Dr. D. Harold Walker	390 Commonwealth Ave	Boston, Mass.
1891—Dr. Edward Wheelock	26 Gibbs St	Rochester, N. Y.
1896—Dr. Fred Whiting	19 West 47th St	New York, N. Y.
1912—Dr. John Gordon Wilson	104 S. Michigan Ave	Chicago, Ill.
1899—Dr. Hiram Woods	842 Park Ave	Baltimore, Md.

OFFICERS.

President—Dr. Herbert S. Birkett, Montreal, Canada.
Vice-President—Dr. George E. Shambaugh, Chicago, Ill.
Secretary-Treasurer—Dr. Thomas J. Harris, New York, N. Y.

HONORARY MEMBERS

(Deceased)

Dr. E. H. Clarke
Dr. Edw. L. Holmes
Dr. Herman Knapp
Dr. A. F. Mayer
Dr. E. Williams
Dr. A. Mathewson

MEMBERS

(Deceased)

Dr. Frank W. Abbott
Dr. John L. Adams
Dr. C. R. Agnew
Dr. W. F. Akin
Dr. H. P. Allen
Dr. Edwin W. Bartlett
Dr. Clarence J. Blake
Dr. Charles H. Burnett
Dr. John P. Davidson
Dr. J. H. Dix
Dr. E. Dwyer
Dr. E. P. Ely
Dr. Edward Fridenberg
Dr. Blancome E. Fryer
Dr. John Green
Dr. Emil Gruening
Dr. Neil J. Hepburn
Dr. James Hewitt
Dr. Christian R. Holmes
Dr. Edgar M. Holmes
Dr. Joseph A. Kenefick
Dr. Gordon King
Dr. Charles J. Kipp
Dr. D. Braden Kyle
Dr. J. W. Lawton
Dr. W. S. Little
Dr. C. J. Lundy
Dr. Stephen H. Lutz
Dr. G. Hudson-Makuen
Dr. Read J. McKay
Dr. Horace J. Miller
Dr. W. W. Moreland
Dr. James E. H. Nichols
Dr. Henry D. Noyes
Dr. J. F. Noyes
Dr. Oren D. Pomeroy
Dr. Barton H. Potts
Dr. Wm. Rankin, Jr.
Dr. J. M. Ray
Dr. Stephen O. Richey
Dr. Charles E. Rider
Dr. F. W. Ring
Dr. Arthur W. de Roaldes
Dr. William K. Rogers
Dr. D. B. St. John Roosa
Dr. Samuel B. St. John
Dr. Wm. W. Seely
Dr. Henry L. Shaw
Dr. Edmund D. Spear
Dr. Frank Sprague
Dr. George T. Stevens
Dr. George Strawbridge
Dr. William Thomson
Dr. Robert Tilley
Dr. J. J. B. Vermyne
Dr. Frederick M. Wilson

AMERICAN OTOLOGICAL SOCIETY

Morning Session, Wednesday, June 1st, 9 a.m., Dr. Wells P. Eagleton, of Newark, presiding.

The fifty-fourth annual meeting of the American Otological Society was held at the Hotel Chelsea, at Atlantic City, June 1st and 2nd, 1921.

The following members were present:

DR. T. PASSMORE BERENS
DR. HERBERT S. BIRKETT
DR. HUGH B. BLACKWELL
DR. F. T. BLODGETT
DR. JOS. H. BRYAN
DR. CHARLES R. C. BORDEN
DR. WILLIAM C. BRAISLIN
DR. R. BISHOP CANFIELD
DR. CORNELIUS G. COAKLEY
DR. CHARLES N. COX
DR. J. FRANK CROUCH
DR. EWING W. DAY
DR. L. W. DEAN
DR. EDWARD B. DENCH
DR. JESSE W. DOWNEY, JR.
DR. ARTHUR B. DUEL
DR. WELLS P. EAGLETON
DR. FRANCIS P. EMERSON
DR. EDMUND P. FOWLER
DR. MAX A. GOLDSTEIN
DR. THOMAS H. HALSTED
DR. PHILIP HAMMOND
DR. THOMAS J. HARRIS
DR. WILLIAM H. HASKIN
DR. R. JOHNSON HELD
DR. J. M. INGERSOLL
DR. FREDERICK L. JACK
DR. PHILIP D. KERRISON
DR. ROBERT LEWIS
DR. JAMES E. LOGAN
DR. JAMES F. McCAW
DR. O. A. M. McKIMMIE
DR. HARRIS P. MOSHER
DR. FRANCIS R. PACKARD
DR. CHARLES E. PERKINS
DR. WENDELL C. PHILLIPS
DR. NORVAL H. PIERCE
DR. JOHN B. RAE
DR. B. ALEXANDER RANDALL
DR. H. O. REIK
DR. GEORGE L. RICHARDS
DR. CHAS. W. RICHARDSON
DR. CHARLES M. ROBERTSON
DR. W. E. SAUER
DR. WARREN S. SHATTUCK
DR. BURT R. SHURLEY
DR. S. McCUEN SMITH
DR. SARGENT F. SNOW
DR. FRANKLYN M. STEPHENS
DR. JOSEPH A. STUCKY
DR. J. J. THOMSON
DR. GEORGE L. TOBEY
DR. D. HAROLD WALKER
DR. JOSEPH A. WHITE
DR. JOHN GORDON WILSON

MINUTES.

Executive Session.

June 1st, 1921, 9:30 a. m. The President, Dr. Wells P. Eagleton in the chair.

The reading of the minutes of the 53rd annual meeting was, upon motion, duly made and seconded, ordered omitted.

The following nominations for membership were made:

Dr. Wesley C. Bowers, New York. Proposed by Dr. E. B. Dench; seconded by Dr. Chas. E. Perkins.

Dr. John McCoy, New York. Proposed by Dr. Chas E. Perkins; seconded by Dr. E. B. Dench.

Dr. Robert Milligan, Pittsburg, Pa. Proposed by Dr. Arthur B. Duel; seconded by Dr. N. H. Pierce.

Dr. Clifton Miller, Richmond, Va. Proposed by Dr. Jos. A. White; seconded by Dr. MacCuen Smith.

Dr. Charles Waldo Stickle, Brooklyn. Proposed by Dr. Wm. E. Braislin; seconded by Dr. Warren S. Shattuck.

Dr. Harold G. Tobey, Boston, Mass. Proposed by Dr. Francis P. Emerson; seconded by Dr. Geo. L. Richards.

Dr. C. T. Porter, Boston, Mass. Proposed by Dr. Geo. L. Richards; seconded by Dr. Francis P. Emerson.

The following nominations for officers for the ensuing year were made by the Council:

President—Dr. Herbert S. Birkett, Montreal, Canada.

Vice-President—Dr. George E. Shambaugh, Chicago.

Secretary-Treasurer—Dr. Thos. J. Harris, New York City.

Additional Member of the Council—Dr. S. MacCuen Smith, Philadelphia.

Upon motion duly seconded, the report was received and unanimously adopted.

Dr. Chas. W. Richardson, Chairman of the Committee on the Deaf Child, presented a report.

Report of Committee on Deaf Child:

At a meeting of the permanent Committee on the Deaf Child, of the American Medical Association, held at Drake Hotel in Chicago, February, 1921, there were present, Dr.

Charles W. Richardson of Washington, D. C., Chairman Dr. Elmer L. Kenyon of Chicago, and Dr. Max A. Goldstein of St. Louis.

It was announced by the chairman that the principal work before this committee was to codify and tabulate the laws in the several states of the Union relating to the education of the deaf, to urge the recommendation to all health authorities, medical officers, etc., in the states where no laws have as yet been enacted; to prompt action in this work, and to suggest improvements in states where such laws are effective, but where they do not as yet meet all of the requirements of the present status for the education of the deaf.

The chairman presented to the committee the laws of various states which had been obtained, through the agency of the Secretary of the American Medical Association. It was impossible to obtain the laws of some states, and some six or more had no laws with regard to this subject.

It was moved that the secretary tabulate these laws. Out of the tabulation which is presented to you, the committee hopes to obtain a satisfactory law which will be standardized and enacted in all states, hoping through this means to make the laws as uniform as possible.

The committee further considered the preparation of a syllabus of lectures for medical schools which shall have for their purpose the instruction of undergraduate students in problems of the deaf and defective in speech. It was agreed that such a syllabus would be presented for consideration of the committee at its next meeting, and that all the medical schools be urged to disseminate such information through their medical departments of oto-laryngology.

The committee finds that through the recommendation of Dr. Goldstein, secretary, who acted as representative of this committee at the Joint Convention of Superintendents, Principals and Instructors of the Deaf at Mount Airy, Pennsylvania, June, 1920, that the following resolution for consideration of the American Association for Promoting the Teaching of Speech to the Deaf, and the Society of Progressive Oral Advocates was presented:

State	Compulsory Education	State School How Managed	Provision for Deaf Children in Large Cities	Age of Acceptance for Admission	Limit of Term of Attendance	Conditions of Admission	Kind of Instruction	Remarks
Alabama	Pupils may be admitted No compulsory law evident.	Board of Trustees	None	7 to 21	Ten years	Citizen of state, sound mind good character and phys	Combined	
Arizona	Sponsorship of State University	State Board of Education	None		Unlimited			
Arkansas							Combined	
California								
Colorado							Combined	
Connecticut							Oral	
Delaware	Sent to Washington, D. C.	Cooperation with commission for blind	See Washington D. C.			Principal of Schools	Oral	Judges of Supreme Court are ex-officio trustees
Dist. Columbia								
Florida							Combined	
Georgia							Combined	
Idaho								
Illinois							Combined	
Indiana	All entitled to education No compulsory law evident.	Board of Trustees					Combined	
Iowa							Combined	
Kansas							Combined	
Kentucky	Act provides for compulsory education. Penalty for violation.	Board of Trustees and Managers		7 to 16	At least nine years	Citizens of state. Healthy	Combined	
Louisiana								
Maine							Combined	
Maryland					7 years	County Commission or Mayor	Combined	
Massachusetts	Compulsory laws. Pupils may not be withdrawn except by consent of Board of Authorities	Board of Trustees	Horace Mann School in Boston		10 years		Oral	
Michigan	Compulsory law	Board of Trustees	Detroit Oral School	7 to 18			Combined	
Minnesota	Compulsory Prosecution and penalty for violation	State Board of Control		8 to 20	Unlimited at discretion of supt.			
Mississippi							Combined	
Missouri	Compulsory law	Board of Managers appointed by Governor		7 years	12 years		Combined	
Montana								
Nebraska	Compulsory. Prosecution and penalty for violation	Board of Trustees	Special provision for deaf children in large cities	7 to 15		Citizens Health Certificate	Oral	
Nevada								
N Hampshire	On recommendation of authorities	State Board of Charities and Correction						
New Jersey							Combined	
New Mexico							Oral	
New York			Oral Day School Provisions in New York City					
North Carolina	Not compulsory	Board of Directors elected by General Assembly.		1 to 23			Combined	White children only
North Dakota								
Ohio	Compulsory. Parents or Juvenile Court		Over 3 years in special local schools at State expense	7 years	14 years	Citizen Health certificate	Combined	
Oklahoma								
Oregon								
Pennsylvania	Compulsory	Board of Trustees		6 to 21			Oral	
Rhode Island							Oral	
South Carolina							Combined	
South Dakota	Compulsory Court to enforce Supt. must notify parent			Proper school age				
Tennessee							Combined	
Texas	No compulsory law. Supt. receives children						Combined	
Utah							Combined	
Vermont	Compulsory. Penalty for violation.	Governor		Legal school age				Provision for instruction in Hartford sch., Clarke sch., Mystic Oral sch., Austine Inst.
Virginia							Combined	
Washington								
West Virginia							Oral	
Wisconsin								
Wyoming								
Philippines	Not compulsory	Bureau of Dependent Children						School for Deaf and Blind in Manila

"Resolved, That we recommend exclusively oral instruction of deaf children and that the oral teaching of the congenitally deaf child and the acquired deaf child be made a part of a department of the public school system in all larger cities."

The American Association Promoting Teaching of Speech to the Deaf had entered into some discussion of this resolution, and had accepted the report of our Committee on the Deaf Child in the following resolution:

First, moved, that the Association has heard with pleasure of the interest of the American Medical Association in the problems of the deaf child, and welcomes the assistance of the American Medical Association in all efforts to reach a satisfactory solution of these problems.

Second, that the copy of this resolution adopted by the American Medical Association be filed with the Secretary of this Association."

The Society of Progressive Oral Advocates endorsed the resolution of the Committee on the Deaf Child in the following motion:

"Moved, That the Society of Progressive Oral Advocates accept the report of the Committee of the American Medical Association and that it endorses its recommendations and will co-operate as far as possible in carrying out the recommendations made."

The Committee finds that the efforts in the matter of a survey and standardization of schools for the deaf has met with some difficulty on account of want of the necessary financing. The Secretary of the Committee has made representations to various foundations and finds that they are unable to finance this proposition, although they see the wisdom of it. It is hoped that during next year this important and necessary step can be so far advanced through presentation to the proper authorities that we will be able to accomplish something in connection with this important work.

Dr. Richardson further reported as delegate to the American Congress of Physicians and Surgeons, that May 2nd and

3rd of next year had been selected as the time of meeting and Washington as the meeting place. The Presidential address was to take place on the evening of May 2nd.

Dr. B. Alexander Randall, the necrologist, presented obituaries of Dr. Arthur Mathewson and Dr. George T. Stevens, deceased during the past year.

ARTHUR MATHEWSON, Past President.

There may be few present who miss two of the older Fellows who have recently "passed over to the majority," yet Dr. Mathewson well deserved the honor of presiding for several years ('95-'97) over this Society, as he also merited his election to the Presidency of the American Ophthalmological Society—little as some of you very up-to-date men can believe that a man may excell in the surgery of both eye and ear! Having many years ago retired from practice and moved to Washington, he was rated among our Honorary Fellows; and after we discontinued our Congress-Meetings in Washington, he rarely attended elsewhere. Graduated in 1861 and a Fellow since 1870, he was a valuable contributor to our proceedings, though oftener in discussions than by papers on the program; and his wide experience as Navy Surgeon during the Civil War, and general practitioner, made his remarks doubly valuable. Of rather short stature, he had none of the self-importance sometimes ascribed to small men, but was notable for the polish and geniality of his dignified poise. Like his colleague, Dr. Prout of the Brooklyn Eye and Ear Hospital, of which they were founders and promoters, it was always a treat to meet and talk with him; and in voicing my regret that I have had few such opportunities of late years, I can earnestly commiserate those of you who did not have the privilege.

GEORGE THOMAS STEVENS.

Dr Stevens was a graduate of the Medical School of Castleton, Vt., in 1857 and practiced many years in Albany before settling in New York City. His work was mainly in Oph-

thalmology and he contributed much to the discussions on the ocular muscles. His nomenclature of the Heterophorias and Heterotropias, when correctly employed, was a real addition to the understanding of this subject; but many who took up these matters with him let their zeal outrun their discretion and inculpated him in the over-doing of "graduated tenotomies." Many of you may remember him as present at our Semi-Centennial Banquet; but he was an infrequent attendant at our meetings and contributed little to our discussions. He was a genial companion and a good listener at our gatherings rather than the storm-center, which he was more apt to be in Ophthalmic Surgery.

Dr. B. Alexander Randall, as Chairman of the Committee of the Society on the Teaching of Oto-Laryngology, made a report. Upon motion duly made and seconded, the report was ordered received, the recommendations adopted and the committee continued.

Summary.

1. We recommend that students preparing for the practice of Oto-laryngology be graduates of Class A medical schools and have completed a year's service as interne in an approved general hospital or its equivalent.

2. We recommend that when possible the preparation for special practice be started immediately after completion of this hospital year. We do not approve of specialization beginning during the under-graduate medical course nor in the interne year.

3. We recommend that the minimum training consist of eighteen months full time work, the first year to be spent in one place. The last six months may be continued here or the work may be pursued in other approved centers. During the first year one half of the time should be devoted to the clinical study of cases, the other half to the study of the fundamental sciences and to library work.

4. All of this work must be on the basis of genuine graduate instruction in which the student does his work individually under proper supervision.

5. The work in the fundamental sciences should be done in properly equipped laboratories such as exist in all Class A medical schools. The clinical work must be done in a properly equipped and properly organized outpatient department of either a Class A medical school or a special hospital, the student serving as clinical assistant.

6. On the completion of the first year's fundamental training the student is advised to secure so far as this is possible the position of interne in a special hospital or of resident in oto-laryngology in a general hospital.

7. For those students who are not able to secure suitable hospital positions after the completion of the first year's fundamental training, the remaining six month's work necessary to fill out the eighteen months' minimum requirement may be taken as continuation of the first year's work in the same institution or by taking special work in other centers. Others may devote the last six months serving as assistant in the practice of some established specialist. When the latter alternatives are followed the work selected must meet the approval of the institution in which the first year's work has been taken.

8. We recommend that on the completion of the above requirements the student be granted a suitable certificate setting forth that he has had the proper preparation for taking up the practice of the specialty. This certificate is to be granted by the institution in which the first year's work has been taken. We make no recommendation regarding the granting of higher degrees. We feel satisfied that such degrees will be granted as readily by the university to those students preparing for the practice of Oto-laryngology as to students in any other field, whenever the work pursued meets the requirements established for the granting of such degrees.

9. We recommend that the student in Oto-laryngology, devote three years if possible, to the study of his specialty.

The Committee hope to be able to assist the candidate in the following ways:

1. Securing from the Graduate Departments of the Universities a suitable degree, to be conferred only upon such candidates as have followed the above course.

2. By correspondence with the Graduate Departments of the Universities, with a view to securing a uniformity in the course of study to be pursued.

3. By arranging with the hospitals referred to above to limit their appointments, as internes, to those candidates who have taken the above course.

4. By preparing a list of hospitals to which candidates may safely be recommended to apply for the position of interne.

5. By securing reliable information as to the facilities offered by various centers, which they may place at the disposal of those who desire to perfect themselves still further in any department in Oto-Laryngology, after the above course has been concluded.

The following members were recommended by the Council for election as members:

Dr. C. B. Faunce, Boston, Mass. Proposed by Dr. F. L. Jack; seconded by Dr. E. A. Crockett.

Dr. Leon E. White, Boston, Mass. Proposed by Dr. F. L. Jack; seconded by Dr. Philip Hammond.

Dr. J. C. Keeler, Philadelphia, Pa. Proposed by Dr. B. A. Randall; seconded by Dr. S. MacCuen Smith.

Dr. Jos. C. Beck, Chicago, Ill. Proposed by Dr. G. E. Shambaugh; seconded by Dr. Norval H. Pierce.

Dr. Geo. M. Coates, Philadelphia, Pa. Proposed by Dr. B. A. Randall; seconded by Dr. Ralph Butler.

Dr. E. B. Gleason, Philadelphia, Pa. Proposed by Dr. B. A. Randall; seconded by Dr. Ralph Butler.

Dr. Isidore Friesner, New York. Proposed by Dr. Wendell C. Phillips; seconded by Dr. John R. Page.

Dr. James G. Dwyer, New York. Proposed by Dr. John B. Rae; seconded by Dr. Wendell C. Phillips.

and to be Honorary members, Dr. Gorham Bacon and Dr. David Webster.

Upon motion, duly seconded, the Secretary was empowered to cast one ballot in favor of these gentlemen and they were thereupon declared duly elected.

The Secretary presented the recommendation of the Council that the excellent work of the American Association of the Hard of Hearing receive the endorsement of the Society. It was moved, seconded and carried that the recommendation be approved.

The Secretary presented the resignation of Dr. G. H. Cox, which upon motion duly seconded, was accepted with regrets. The Secretary of the Council recommended that Dr. R. W. Seiss be dropped from membership. Upon motion duly seconded, the recommendation of the Council was adopted.

The President read his address: "Irrigation of the Subarachnoid Space for Meningitis, with Report of Cases."

In a few introductory remarks, Dr. Eagleton expressed his appreciation of the honor conferred upon him by the Society in electing him president. In recalling events in his professional career which had given him particular gratification, he spoke of his election as Medical Director of the Newark Eye and Ear Infirmary; his appointment as chief of the Section of Surgery of the Head at the Base Hospital, Camp Dix, during the war; his election as an executive officer of the Medical Society of the State of New Jersey; and last in order, but not least in his estimation, his election as President of the American Otological Society.

These four appointments, he said, stand out in his mind as epochs of his professional life which most strongly impress him, and he wished again heartily to express his appreciation to the Society for the honor of its presidency. He feels that the conferring of these offices upon him represent a display of confidence in him by large and influential bodies of members of the Medical Profession in which he has spent his life.

The secretary presented the recommendation of the Council that an assessment of $15 per member for the ensuing year should be levied. Moved, seconded and carried that the recommendation of the Council be adopted.

The Treasurer presented the following report:

Expenditures for 1920-1921.

June 22, 20.	Clerical Hire, T. J. H.	$ 50.00
June 25.	L. H. Biglow	80.53
July 7.	Walter R. Steiner	129.00
July 7.	L. H. Biglow	47.53
July 13.	V. B. Alvarez	127.89
Oct. 12.	L. H. Biglow	8.75
Oct. 23.	Postage	2.00
Dec. 22.	L. H. Biglow	15.90
Dec. 28.	Mercury Publishing Co.	500.00
Dec. 29.	Stamps	2.00
Jan. 13.	L. H. Biglow	53.50
Jan. 31.	Mercury Publishing Co.	239.03
Feb. 11.	Stamps	4.00
Mar. 12.	L. H. Biglow	15.25
Apr. 21.	Clerical hire, etc., T. J. H.	61.95
May 9.	Cablegram (Hunter Todd)	2.73
	Bank Exchange	3.41
	Total	$1,345.47

Balance brought forward:

June 1, 1921	$ 33.34
Receipts from assessments	1,601.74
Stamps from Treasurer	.16
R. J. Held	15.00
Total	$1,650.24
Expenditures as above	1,345.47
	$304.77

It was moved, seconded and carried that the Secretary be authorized to cast one ballot for the several gentlemen recommended for officers for the year 1921-22, by the Council. Whereupon these gentlemen were declared duly elected.

It was moved, seconded and carried that the following cablegram be sent to the Otological Section of the British Medical Society:

The Council recommends that the Society express its appreciation to the Otological Section of the Royal Society of Medicine for its invitation to hold a conjoint meeting this summer in England, and its great regret for any misunderstanding in connection with this invitation, and for the impossibility of acceptance on account of the small number of delegates who will be able to attend.

As the American Otological Society is earnestly desirous of a close co-operation of both societies, the American Otological Society wishes to extend to the Otological Section of the meeting in connection with this Society next year, in Washington, May 2nd and 3rd, 1922, at the time of the Congress of Physicians and Surgeons, and if this is not possible, that delegates may be sent to attend the American meeting.

Dr. Pierce moved that the President appoint a committee to consider the scope and plan of an investigation of the subject of otosclerosis, to report at the next meeting of the Society. The motion was duly seconded and carried. The President appointed the following:

Drs. Pierce, chairman; Wilson, Shambaugh, Cahill, Dwyer, as such committee.

Dr. Pierce moved that the Chairman appoint a committee on the standardization of tuning forks. The motion was duly seconded and carried. The President appointed:

Drs. Dench, chairman; Wilson, Dean, Randall, as such committee.

Dr. Day, as auditor, reported that the books of the Society had been examined and found correct.

Dr. Shurley moved that the Society send its congratulations to the Laryngoscope on its twenty-fifth anniversary. This was duly seconded and carried.

Adjourned.

THE PRESIDENT'S ADDRESS.

THE OPERATIVE TREATMENT OF SUPPURATIVE MENINGITIS WITH ESPECIAL REFERENCE TO IRRIGATION OF THE CRANIAL AND SPINAL SUBARACHNOID SPACES; AND THE IMPORTANCE OF PROTECTIVE MENINGITIS FROM A PROGNOSTIC AND THERAPEUTIC STANDPOINT. WITH AN ANALYSIS OF THE CASES OF RECOVERY —EXCLUSIVE OF MENINGOCOCCIC—REPORTED IN THE LITERATURE.

By WELLS P. EAGLETON, M. D., Newark, N. J.

INTRODUCTION.

This paper is presented at length because a compilation by the author, assisted by Dr. F. Robbins, of all the recorded cases of recovery from suppurative meningitis—exclusive of meningococcus meningitis—shows that the number of true cases is even smaller than is generally supposed. Many of the reports in which an operation is said to have been followed by recovery contain no positive evidence — the evidence of micro-organisms in the fluid obtained by lumbar puncture—of there having been a bacterial invasion of the general cerebro-spinal fluid system. In fact, many reports frankly state that the fluid was sterile. Doubtless the majority—if not all—of these cases were suffering, not from a suppurative but from a protective meningitis, those who reported them evidently regarding these essentially different processes as identical. The paper is given with the hope that by a re-study of the pathological, clinical and experimental evidence now available the surgeon of the future may come, not only to a better understanding of this group of diseases, but to a more rational and successful treatment of them.

In the light of recent experiments in induced suppurative meningitis we should revise some of the opinions previously accepted. In meningitis we are dealing with a septic process

confined to a physiological system of the brain—a circulatory system that is anatomically as distinct and definite as the blood or the lymphatic systems.

Infection of this circulatory system—suppurative meningitis -causes profound toxemia because with an inflammatory process within the cerebro-spinal fluid system the products of the inflammation, its toxins, etc., are poured into the general blood circulatory system, into which it empties by osmosis.

In suppurative meningitis the brain tissue is only secondarily involved, and consequently cerebral compression, which plays such a large and important role in *cerebral tissue suppuration*—or brain abscess—is but seldom present. When present it is secondary to obstruction in the cerebro-spinal fluid system and not to increase in the brain bulk, as in brain abscess.

The fundamental facts that (1), suppurative meningitis is primarily a disease of the cerebro-spinal fluid system -a circulatory system which, while intimately associated with the cerebral tissue and blood circulatory system, is still distinct from it -and that (2), the cerebral tissue is only later and secondarily involved, are of prime importance in approaching the subject from a surgical standpoint. Consequently in thinking of suppurative meningitis we should not regard it as in any way analogous to brain abscess, but rather as akin to a combination of thrombosis and a cerebral arterial embolism -the former a septic process and the latter causing a disturbance in the nutrition and metabolism of the cerebral tissue. Even this analogy is so imperfect that there is no real profit to be derived from its application.

Classification.

Suppurative Meningitis a Group of Diseases.

Clinically as well as experimentally suppurative meningitis should not be regarded as a disease but as a group of diseases of the cerebro-spinal fluid circulatory system. From an etiological and general standpoint they may be divided as follows:—

1. Meningitis from a localized extra-dural focus of adjacent infection—ear or accessory sinus—the meningitis oc-

curring either through direct extension, thrombophlebitis, or "from trauma, with secondary general spread". (Netter.)

2. Meningitis secondary to focal brain abscess (Bull, 1916; Detweiler and Maitland.)

3. Meningitis as part of an overwhelming blood infection, in which meningitis is only one, and frequently the least conspicuous lesion. (Bull, 1917.)

4. Meningitis generalized from the beginning, which appears to be the cause of death rather than the septicemia or its accompanying lesions. (Austrian, Elser and Huntoon.)*

While the etiological process must always be the commanding factor in deciding whether or not a disease is amenable to surgery —for to operate for a local manifestation of a general disease must necessarily in the vast majority of cases be fruitless—the actual anatomico—pathological condition present becomes of prime importance once it has been decided surgically to attack a suppurative meningitis.

Surgically, then, cases of suppurative meningitis should be divided into

(1)—fulminating types;

(2)—exudative types,

(a) acute exudative,

(b) subacute and chronic exudative;

(3)—protective types.

The surgical procedure to be adopted in an individual case, if any degree of success is to be obtained, must take into consideration both the etiological factor and the pathological condition present.

Anatomy of the Cerebro-Spinal Fluid System.

The cerebro-spinal fluid circulates within closed cavities and tubes—the ventricles, the cisterna and the subarachnoid spaces constituting the cerebro-spinal circulatory system—somewhat as the blood circulates in the blood vascular system: and like the walls of the vascular system, the walls of the cerebro-spinal circulatory system are normally impermeable to the contained fluid.

*(Modified from) Ayer, J. B.: A Study of Experimental Meningitis; Experimental Acute Hematogenous Meningitis; *Monographs of the Rockefeller Institute for Medical Research*, No. 12, March 25, 1920.

The cerebro-spinal fluid finally empties into the blood stream after performing its functions in the brain, passing by osmosis into the venous sinuses of the head, and at certain points, where the system has passed outside of the cranium, communicating, again by osmosis, with the extra-cranial lymphatic system. This communication occurs along the arachnoid prolongations around the sheaths of certain nerves, especially the olfactory and the auditory.

Thus while the cerebro-spinal fluid circulatory system is a closed system without an apparatus for the purification and return of its fluid, such as the vascular system has in the heart and lungs, it utilizes both the vascular and the lymphatic systems for its discarded material much in the same way as the blood vascular system utilizes the kidneys; with this difference, however, that while the blood discharges through the kidneys only its deleterious material, the entire cerebro-spinal fluid constantly is being discharged into the blood or the lymphatic system.

Viewed, then, in a large way, both anatomically and physiologically, the cerebro-spinal fluid circulatory system *must* be of importance to the cerebral functions. Why its study was so long disregarded is to be explained by the delicacy of its anatomy.*

The circulating cerebro-spinal fluid is produced chiefly from the choroid plexus within the ventricles, the walls of which are lined by cells, the ependyma, which are impervious

*1: Weed, Lewis H.: Studies on Cerebro-Spinal Fluid; *Journal of Medical Research*, Sept. 1914, Vol. XXXI, pp. 21-117.

2: Wegeforth, Paul and Weed, Lewis H.: Studies on Cerebro-Spinal Fluid; *Journal of Medical Research*, Sept. 1914, Vol. XXXI, pp. 167-176.

3: Weed, Lewis H. and Cushing, Harvey: Studies on Cerebro-Spinal Fluid; *American Journal of Physiology*, January, 1915, Vol. XXXVI, No. 2.

4: Cushing, Harvey, and Weed, Lewis H.: Studies on the Cerebro-Spinal Fluid and its Pathways; *Johns Hopkins Hospital Bulletin*, November, 1915, Vol. XXVI, No. 297.

5: Weed, Lewis H.: The Formation of the Cranial Subarachnoid Spaces. *The Anatomical Record*, May 1916, Vol. X, No. 7.

6: Weed, Lewis H.: An Anatomical Consideration of the Cerebro-Spinal Fluid; *The Anatomical Record*. May, 1917, Vol. XII, No. 4.

7: Weed, Lewis H. and McKibben, Paul S.: Pressure Changes in the Cerebro-Spinal Fluid Following Intravenous Injection of Solutions of Various Concentrations; *American Journal of Physiology*, May, 1919, Vol. XLVIII, No. 4.

8: Weed, Lewis H. and McKibben, Paul S.: Experimental Alteration of Brain Bulk; *American Journal of Physiology*, May, 1919, Vol. XLVIII, No. 4.

9: Weed, Lewis H.: The Cells of the Arachnoid; *Johns Hopkins Hospital Bulletin*, October, 1920, Vol. XXXI, No. 356.

10: Macklin, Charles Clifford, and Macklin, Madge Thurlow: A Study of Brain Repair in the Rat by the Use of Trypan Blue; *Archives of Neurology and Psychiatry*, April, 1920, Vol. III, pp. 353-394.

to the fluid. From the ventricles the fluid passes by a process of overflow through the foramen of Sylvius into the fourth ventricle, and leaves it by the medial foramen of Magendie and the lateral foramina of Luschka; from these it spreads over the base of the brain, and accumulates in the large basal cisterna, whence it is distributed, by way of the sponge-like communicating meshes of the sub-arachnoid spaces over the cortex, along the vessels and convolutions, emptying at last, by osmosis, into the venous sinuses.

In its passage over the cortex there is contributed from the cerebral substance—through the prolongations of the sub-arachnoid spaces along the vessels entering or leaving the cerebral tissue called the perivascular spaces—a small amount of cerebro-spinal fluid which has a somewhat different composition from the cerebro-spinal fluid formed in the ventricles. These perivascular channels, opening directly into the sub-arachnoid spaces of the cortex, are undoubtedly the means of direct communication between the intra-cellular juices of the brain cells—the perineural system—and the general cerebro-spinal circulatory system.

The cerebro-spinal fluid acts to remove the waste products of the brain, but whether it supplies any nutritive ingredient necessary to the continued functioning of the brain is not known. It is inconceivable that it does not possess some such quality, especially as one of its normal contents is a sugar reacting substance.

Impregnability of Cerebro-Spinal Fluid System: The cerebro-spinal fluid system, while anatomically composed of very delicate cells, is very resistant to infection when attacked either upon its external surface, or internally, from the cerebral tissue; and while in close anatomical proximity to the blood circulatory system—being separated from the pial vessels by only one layer of cells and actually surrounding the vessels as perivascular spaces—when uninjured the cerebro-spinal fluid system does not allow of the invasion of the sub-arachnoid spaces by bacteria circulating free in the blood stream. The cells of the arachnoid offer an efficient barrier to such an invasion. With micro-organisms in free circulation

in the blood stream, however, a slight disturbance of the normal protective mechanism—such as would be occasioned by the withdrawal of a small amount of the cerebro-spinal fluid, the presence of an aseptic meningitis, or the temporary stoppage of the blood current—is enough to permit the passage of the free bacteria from the blood system into the cerebro-spinal fluid system, and a suppurative meningitis follows:

Bacteriological Classification of Meningitis: Clinically, otologists have come to recognize three different types of meningitis, the differentiation largely being based upon (a), the supposedly different degrees of virulence of the infecting micro-organisms in the leptomeninges, with (b), the associated alterations in the cerebro-spinal fluid, (c), the proportionate rapidity of a fatal termination, and (d), the different terminal post mortem findings.

The classification at present generally accepted is—

I—*Fulminating Pneumococcus Leptomeningitis,* (frequently described as streptococcus mucosa). This type of meningitis is usually regarded as coincident with a general blood-stream infection, although personally I have never accepted this view. In my experience nearly all of the cases have been preceded by an acute otitis media or a mastoid involvement. These cases all ended fatally, sometimes very quickly, and the post mortems revealed a general leptomeningitis with numerous hemorrhages into the piarachnoid, with or without a small amount of exudate:

II—*Streptococcus and Staphylococcus Meningitis,* (much more common, but not so virulent), which generally follows a chronic or acute local focus of adjacent infection—otitis, sinusitis, or cranial osteitis such as accompanies an infected compound fracture of the skull—and which surgeons have come to regard as the breaking down of an initial local immunity, generally through direct extension into the meninges. (Koerner). These cases, while of much longer duration than the former, have an almost equal fatality, the post mortem invariably showing great areas of exudation covering the basal cisterna:* and, least virulent of all,

*Day, Ewing W.: Report of Eight Cases of Purulent Meningitis. Operated upon by the Haines' Method. Post Mortem Findings. *The Laryngoscope,* November, 1913.

III—*Meningococcus Meningitis*, with a cloudy or opaque cerebro-spinal fluid, containing, however, comparatively few micro-organisms. This type, even before the discovery of a specific serum had a fair proportion of recoveries.

Fulminating pneumococcus meningitis, of acute aural, accessory sinus or blood-stream origin; streptococcus meningitis, of chronic or acute aural, nasal or cranial bone origin; and meningococcus meningitis, probably of nasal or blood-stream origin, are clinical entities. Fulminating pneumococcus meningitis is characterized by a high virulence of the micro-organisms, and imperfect or absent tissue protective reaction. The mode of invasion is unknown, but probably is from a direct invasion of the subarachnoid spaces through the blood vessels, or of the subarachnoid space prolongations along the olfactory nerve. Meningococcus meningitis is characterized by a prompt tissue protective reaction as shown by the early appearance of a cloudy fluid filled with leucocytes, and with but few micro-organisms, the latter disappearing either spontaneously or after the injection of serum or antiseptics. The mode of invasion in this type also is unknown, but probably is directly from the nasal mucous membrane, or from the blood stream itself, as a majority of the cases are found to have a blood-stream infection concurrent with the meningitis. Midway between these two types, both in virulence and in duration, stands the streptococcus and staphylococcus meningitis of local origin.

With the acceptance of such a classification it was natural that treatment should be largely empirical and based upon attempts at (1), the establishment of drainage, (2), the injection of a specific serum, and (3), the relief of compression. Belief in a concomitant blood-stream infection in pneumococcus meningitis caused the surgeon to throw up his hands as soon as pneumococci were demonstrated in the cerebro-spinal fluid.

It is one of the purposes of this paper to emphasize my belief that, if progress is to be made in the surgical treatment of meningitis, this generally accepted bacteriological classification must, to a large extent at least, be superseded

by a classification which is based upon the etiological factors and the pathological findings in experimentally induced meningitis; for it is by experiment alone that the location, course and extent of the lesions during the initial period can be discovered.

The knowledge derived from the experimental production of purulent meningitis—chiefly by Weed, Wegeforth, Ayer, Felton and Essick*—should, I think, cause us greatly to modify our views, as it makes possible a more philosophical understanding of meningitis as a whole, and, consequently, a more rational line of treatment. To accomplish this, however, I believe it is necessary that we make an effort to visualize the pathological process in its different stages, *modified as it is by the protective and reactive influences of the protective meningeal mechanism.*

Experimental evidence favors the view that the grade of the meningitis depends, not entirely upon the *kind* of invading micro-organisms, but also upon the quantity of them, as all types of pyogenic micro-organisms, if implanted in sufficient quantity in the subarachnoid spaces, will induce a meningitis of greater or less severity.**

This being so, then in many cases there must be a period of latency when the micro-organisms, although virulent, are not of sufficient number to obtain command. Such is indeed

1: Weed, Lewis H., Wegeforth, Paul, Ayer, James B., and Felton, Lloyd D.: A Study of Experimental Meningitis. A Series of Papers from the Army Neuro-Surgical Laboratory; *Monographs of the Rockefeller Institute for Medical Research*, No. 12, March 25, 1920.

2: Weed, Wegeforth, Ayer and Felton: The Production of Meningitis by the Release of Cerebro-Spinal Fluid; *Journal A. M. A.*, Jan. 18, 1919, Vol. 72, pp. 190-193.

3: Wegeforth, Paul, and Essick, Charles R.: The Effect of Sub-Arachnoid Injections of Antiseptics upon the Central Nervous System; *Journal of Pharmacology and Experimental Therapeutics*, July, 1919, Vol. XIII, No. 4.

4: Weed, Lewis H. and Wegeforth, Paul: Experimental Irrigation of the Sub-Arachnoid Space; *Journal of Pharmacology and Experimental Therapeutics*, July, 1919, Vol. XIII, No. 4.

* * Either the natural protective mechanism (natural immunity) is present in a very small degree within the meninges or the central nervous system is extremely sensitive to bacterial toxins;" but

"The fact that the same numbers of virulent streptococci on injection both into the sub-arachnoid space and into the peritoneal cavity result in a fatal infection indicates that the sensitivity of the meninges was not alone the determining factor in the reaction. It seems most likely that in both cases we are dealing with a mesothelium lined sac serving as a good incubator, with enough nutriment for the development of the bacteria injected and with very slight inhibitory power of the body elements."

However, "there are immune bodies in the cerebro-spinal fluid of immunized animals."

Felton, L. D.: The Intra-Meningeal Virulence of Micro-organisms; *Monographs of the Rockefeller Institute for Medical Research*. March 25, 1920, No. 12, p. 45.

clinically the case in the latent period of pneumococcic infection, as recorded by many observers, when, with pneumococcic type III organisms in the cerebro-spinal fluid, there are few or no clinical manifestations of meningitis.

Experimentally induced meningitis from a blood-stream infection, demonstrates that in meningitis of blood-stream origin at least, the meningitis (1), originates in the subarachnoid spaces chiefly *over the cortex* of the cerebral hemispheres; and further that (2), the infection is at first confined to the subarachnoid spaces of the cerebro-spinal system, and (3), extends in a direction contrariwise to the direction of the cerebro-spinal fluid circulation, namely, from the cortex to the basal caption; that (4), as long as the infection is thus confined there is no *involvement of the cerebral tissue itself*, whatever changes occur in the tissue being of a protective and not of an infective nature; but (5), on *reaching the ventricles* infection of the brain tissue appears, and also infection of the blood vessels of this region; that (6), the outstanding pathological manifestation of septic infection of the cerebro-spinal fluid system is the production of an exudate, in part inflammatory and in part protective, which plugs the cerebro-spinal circulatory system, *and so prevents proper cerebral functioning.*

Toxicology of the Cerebro-Spinal Fluid System.

Effect of Alterations in the Chemical Composition and Temperature Changes in Fluids Passed Through the System. Weed and Wegeforth* demonstrated that apparently trivial alterations in the chemical composition of the fluid *passing through* the cerebro-spinal fluid system are highly toxic; even if neutral in composition, the fluid must contain a small proportion of calcium and the temperature of the fluid must be at about that of the body; otherwise lethal, respiratory and circulatory disturbances associated with acute nausea quickly follow.

Foreign substances *injected into* the subarachnoid space,

*1. Weed, Lewis H. and Wegeforth, Paul: Experimental Irrigation of the Sub-Arachnoid Space; *Journal of Pharmacology and Experimental Therapeutics*, July, 1919, Vol. XIII, No. 4.

on the other hand, while causing marked symptoms of general body reaction, are not necessarily followed by death.*

Surgical Types of Meningitis.

Adaptations of Clinical Types to Pathological Lesions Occurring in Experimentally Induced Meningitis: The clinical manifestations and post-mortem findings in cases of suppurative meningitis being similar to the clinical history and pathological lesions of experimentally induced meningitis, I believe that the generally accepted bacteriological classification should largely be abandoned and for surgical purposes the etiologico-pathological classification of induced meningitis (Ayers) adopted, suppurative meningitis being, as already stated, divided into four types.

In the first type or the Acute Fulminating Type—the outspoken symptoms are, a profound blood-stream sepsis, rapid pulse, high temperature, great prostration, plus the presence of a *distinctly cerebral* element manifested by intense headache, vomiting, restlessness, delirium, and a death clinically different from the death by exhaustion usual in sepsis. The fatal termination often occurs very suddenly while the patient apparently is in good health. This form of death has been explained as due to a "derangement of the controlling cerebral mechanism."**

Post-mortem examination shows multiple hemorrhages in the piarachnoid—an evidence of the virulence of the poison ing in the blood vessels. This type corresponds in all particulars to the acute fulminating cases of pneumococcus meningitis. This fulminating type, however, frequently is preceded by periods of quiescence in which, although the micro-organisms are present in the cerebro-spinal fluid, few symptoms are manifest, the patient apparently being fairly well, the only clinical evidence of the impending fulminating meningitis being a moderate and irregular elevation of temperature, possibly irregular vomiting and headache—all of them symptoms of cerebral suppuration.

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* Weed and Essick, and Weed and Wegeforth. Loc. cit.

** Kopetzky, Samuel J.: The Operative Treatment of Meningitis; *The Laryngoscope*, August, 1914.

General Blood-Stream Infection Secondary to the Fulminating Meningitis:

In the fulminating meningitis of otitic origin, at least, I believe the general blood-stream infection is secondary to the meningitis, as an otitis invariably precedes the meningitis for varying periods, although in a few cases in my experience a blood-stream infection apparently was present from the beginning. In one case death occurred 72 hours after the initial earache, the post-mortem showing hemorrhages in the pia, while the serous fluid within the nasal accessory sinuses was loaded with the invading micro-organisms. To both of these pathological conditions I was the first, so far as I am aware, to call attention.*

Although some of my cases of sudden fulminating meningitis doubtless followed a mastoid operation and were latent meningeal infections from an early period of the illness, as a careful examination of the history of Case VIII will demonstrate, in all of them nevertheless, an aural suppuration preceded the meningeal manifestations by an appreciable interval. (See also Case V).

Examination of the cerebro-spinal fluid at this time may show but moderately increased pressure, a slightly increased cell count and an apparent absence of micro-organisms, the latter being so few as to be overlooked for considerable periods of time, even by expert bacteriologists. Combined with the fact that at the outbreak of the meningeal manifestations the invading micro-organisms in the cerebro-spinal fluid were so few as on numerous occasions to be overlooked, I am persuaded that these cases originally are a strictly local aural, or possibly nasal, infection, the succeeding meningitis being of such severity as to occasion more or less promptly a blood-stream infection.

This view is substantiated by the clinical observation of the invariable absence of micro-organisms in the blood culture in the early stages of the disease, and by the experimental observations of Felton and Wegeforth (loc. cit.): "In all acute fatal cases of experimentally induced meningitis caused by the injection of micro-organisms into the subarachnoid space, every culture of the heart's blood showed

*Society Proceedings, New York Otological Society, meeting of January, 1917, *Annals of Otology, Rhinology and Laryngology*, 1917, Vol. 26, p. 1060.

the presence of the same bacteria with which the animal had been inoculated intra-spinously."

And more conclusive still, if the animal recovered from the meningitis and later died, "the micro-organisms could still be obtained from the blood, although the meninges were clear."

From clinical and experimental evidence, then, fulminating meningitis (pneumococcus), when preceded by a known focus of primary infection (in the ear or nasal sinuses), should be regarded as a *secondary* infection, the meningitis itself—by an overwhelming attack of virulent micro-organisms—causing an almost immoderate bloodstream infection by their direct action on the blood vessels. Those cases in which an apparently sudden onset and a rapid course are followed by a fatal termination after a period of quiescence, would suggest that at a certain point the protective forces within the meninges which have been in control are suddenly overpowered, thus allowing complete bacterial domination—especially as the sudden outburst at times is associated with the clinical picture of profound hemogenic toxemia as well as of cerebral function involvement. Such a view, although precluding surgical intervention in the acutely fulminating cases, offers a much more favorable outlook in the cases in which the blood vessels are not immediately attacked than if we regard the meningitis as concurrent with a general blood-stream infection.

Case I. Acute Fulminating (Pneumococcic Type III) Meningitis:

Synopsis: Following an aural suppuration, outspoken meningeal manifestations on the third day; rapid death. *Post Mortem*: Pneumococci in sub-arachnoid spaces; slight exudate; numerous hemorrhages in pia, protective leucocytic infiltration of cerebral cortex; pneumococcic invasion of affected mastoid and of the mucous membrane of several nasal accessory sinuses, the latter being possibly a secondary infection from the blood stream, although a negative blood culture was obtained but a few hours before death, and there was no evidence of protective reaction in the mucous membrane of the accessory sinuses as would have been the case if the nasal sinuses were the primary focus of infection.

Clinical History: On January 20, 1918, patient had his first ear ache. When he arrived at hospital on January 21st, the ear was discharging a

waterish, yellow exudate. This continued on the 22nd and 23rd. Examined repeatedly by Dr. Earl Brooks, who said he might have had a little tenderness over the mastoid, but thought not. Patient had been feeling comparatively well, so far as his neighbors in the ward knew. His temperature, however, on the 23rd, reached 102°; on the 24th, 101 2/5°; late in the afternoon of the 24th, 102-2/5°. The nurse stated that during the whole of the 24th the patient seemed in stupor, but was easily aroused and talked. At 3.30 he vomited while having his nose sprayed. At 5 o'clock he sat up in bed and said to the nurse, "I do not think I can hold the basin to have my ear syringed," but he did hold it. About 5.15 he asked the nurse to give him a drink of water. I had passed the patient's bed at 4 o'clock and had not noticed his appearing sick; but suddenly at 6 o'clock, while I was in the ward, the man vomited and had a convulsion, and when I reached his bed he was in coma, with widely dilated pupils and nystagmoid movements of his eyes.

Following this attack the patient became slightly conscious, but could not be fully aroused. Lumbar puncture at 7 p. m.; the fluid, under great pressure, was rather cloudy, with grey streaks—looked like the fluid seen in cerebro-spinal meningitis, and I thought this probably was the case. Examination of the eyes was negative. The bacteriological examination showed pneumococci. The precipitin test was positive for type III. A blood culture was negative. About 8 o'clock he had a rather active chill and his temperature rose rapidly. Death in deep coma, within 6 hours of the initial convulsion.

Autopsy and Report by Dr. B. F. Weems, Jr.

Clinical Diagnosis; Pneumococcus Meningitis.

Anatomical Diagnosis; Otitis media and mastoiditis (left side); ethmoiditis and right frontal sinusitis; cerebro-spinal meningitis.

External Examination; Body of adult white male, approximately 23 years of age, medium size, well developed and nourished, rather muscular. Adenoid type of facies, poorly developed dental arches, and weak chin. Bodily conformation and hair distribution distinctly masculine. Rigor mortis general and very pronounced; the usual purple blotches of hypostatic congestion seen on dependent portions of skin. External genitalia normal. Orifices negative.

Internal Examination; Brain: Calvarium was removed in the usual manner and the brain lifted out without separating the dura from the hemispheres. An abnormal cloudiness was apparent in the piarachnoid spaces at the base of the brain. There was a general engorgement of the vessels of the entire brain, those of the cerebral cortex especially. The usual cloudiness due to coagulated lymph along the larger vessels in the Sylvian fissure and some of the sulci, was much augmented by a cellular exudate. There was no appearance of a frankly purulent exudate,

however. *The most marked characteristic of the picture was due to the innumerable capillary hemorrhages scattered over almost the entire surface.* These appeared to be just beneath the pia, the extravasated blood spreading out in a thin film over the brain surface. The film was thin enough and extensive enough over the cerebellum to give the whole of the posterior and inferior surface of this organ an almost homogeneous pink color. The hemorrhagic condition was *most in evidence over both temporal lobes.* Here it was apparent that many little hemorrhages had taken place from the small arterioles that entered the cortex. Upon the anterior and superior curvatures the hemorrhagic process was less developed.

Base of Skull: Nothing abnormal was to be observed in the dura or about the nerve endings and foramina at the base of the brain. The antrum and the neighboring cells in the petrous portion of the temporal bone were separated from the overlying dura by a thin, almost transparent membrane. *This thin membranous character of the bony wall was noticed only in several small spots;* otherwise the surface appeared perfectly normal and unbroken. Within the mastoid antrum and the adjoining mastoid cells there was a slightly turbid exudate. The mucous membrane was everywhere thickened, soft and turgescent. *Deeper down in the middle ear there seemed to be little or no exudate.* The antrum and mastoid cells in the right temporal bone were found to be perfectly normal.

The ethmoid cells displayed the same juicy condition, all the cells being filled with slightly turbid fluid, and *the mucous membrane being much swollen and soft.* On the right side the sphenoid sinus contained some thin mucous secretion and the membrane appeared swollen. The cells of right frontal sinus appeared very much like those of the left mastoid. They were filled with thin, turbid exudate and the mucous membrane was even more striking in its thickened, turgid character. Several very small capillary hemorrhages were to be seen in its substance.

Anterior mediastinum appeared normal. Thymus gland was quite large about 9 cm. long by perhaps 5 cm. wide, and 1 cm. thick. It was removed in toto and preserved for closer study. Both pleural spaces were perfectly normal.

Lungs: Both organs presented a typical picture of acute congestion. The consistency was rather firm, but homogeneous; the cut surface very moist, smooth and of a dark red color. Considerable bloody fluid could be scraped up on the blade of the knife. Some air was contained in all parts of the tissue folds. Bronchi and vessels appeared quite normal.

Heart: Pericardium normal. Beneath the epicardium of the left ventricle there were numerous petechial hemorrhages. This ventricle

was in tight contraction, while the right side of the heart was quite flaccid. Endocardium, valves and heart muscle normal.

Peritoneum: Smooth, moist and glistening. Appendix deep in the iliac fossa. Transverse colon hung down below the umbilicus. Mesenteric glands appeared quite normal.

Spleen: Malpighian follicles stood out very prominently, otherwise organ was normal.

Kidneys: A very perfect example of the *Horseshoe Kidney*, the pelves and the two separate ureters being perfectly developed. The pelves were situated anteriorly to the kidney substance and the ureters passed downward over the bend of the horseshoe. The capsule stripped readily at the left pole. There was no evidence of abnormal condition on the surface. The organ was not sectioned.

Liver: Showed some acute congestion.

Pancreas: Appeared likewise to be somewhat congested.

Gall-bladder: Distended with normal-looking bile; no stones. No further dissection was made.

BACTERIO-HISTOLOGICAL REPORT.

a. Smear of fluid at base of brain showed polymorphonuclear leucocytes and abundant pneumococci. Culture gave pneumococci in pure growth.

b. Brain hardened in 4% formaldehyde and sections showing lateral surface of right hemisphere and median surface of left were prepared for museum.

c. Sections of cortex in temporal region showed a mixed hemorrhagic and purulent exudate in the spaces of the piarachnoid, in which a few pairs of pneumococci could be demonstrated. Many polymorphonuclear leucocytes could be seen passing through the walls of the capillaries in the superficial layers and invading the cortex.

N. B. The cortex, while the seat of polymorphic leucocytes—a protective reaction—was not invaded by the micro-organism itself.

d. Dura over left temporal bone was extensively invaded with polymorphonuclears, indicating the penetrating infection.

e. Smear from mastoid cells showed an occasional pneumococcus, many polynuclears. Culture showed pneumococci.

f. Smear from middle ear showed pus cells but no cocci could be found. Culture gave pneumococci.

g. Smear from ethmoid cells showed many pneumococci. Culture gave pneumococci and staphylococcus aurea.

h. Smears from mucous of right sphenoid sinus showed innumerable Gram negative and positive cocci and bacilli. Culture showed similar mixed flora.

i. Smears from mucous membrane of frontal sinus showed pneumococci in abundance. Culture gave pneumococci.

j. Sections of the tissue of the frontal sinus showed a *very marked edema of the sub-mucous tissues, especially of the epithelium and the adjacent layer.* Pneumococci found in sections.

k. Thymus was rather larger than usual.

l. Sections of the lung showed the typical picture of acute congestion and edema.

m. Horseshoe kidney preserved as a museum specimen.

n. Liver sections showed *engorgement of the capillaries about the intra-lobular vein*, with slight vacuolization of the liver cells in this region. Also there was a slight *general infiltration of the liver tissue with polymorphonuclear leucocytes. No abscess formation, but more leucocytes wandering out of the blood vessels than is normally the case.*

In the majority of cases, however, (even those of pneumococcic type III. infection), the bacterial invasion is not so overpowering—the bacteria being either too few, or else limited by the protective meningeal mechanism: in which case we have an exudative type—a much longer process, clinically and pathologically different.

II. *The Exudative Types*—the usual form of suppurative meningitis from direct extension of a streptococcic or staphylococcic infection of an adjacent structure, as the ear, nasal sinus, or bony cranium.

II—(a) *Acute Exudative*: The exudative type in reality is but a milder degree of the first, or fulminating type. *It has this difference, however, that part of the pathological process is not bacterial, but protective*, as the exudate is partly the product of the protective chorio-meningeal mechanism in its efforts to limit the bacterial and toxic influences. This exudate, however, by its presence adds to the damage by interfering with the cerebro-spinal fluid circulation, unless it is limited to a small area, and thus a vicious circle is established to the advantage of increased bacterial growth and extension. It is this exudate which, by filling the sub-arachnoid spaces and thus disturbing the proper functionating of the brain, causes the earlier cerebral manifestations, while the accompanying symptoms of toxemia originate from the products of the inflammation discharged into the blood stream by the cerebro-spinal fluid, and the terminal symptoms of cerebral compression are due to the invasion of the foramina

of Luschka and Magendie* from extension of the exudate into the ventricles and the cerebral tissue.

The patient usually lives for ten to fourteen days, or even longer, during which time there may be periods of apparent recession of the infection, giving hope of ultimate recovery, only to end, however, in all but very exceptional cases in death.

Case II: Exudative Meningitis (of pneumococcic origin):

Child, seven years of age. Seen in consultation with Dr. B. B. Ranson and Dr. Linn Emerson.

Synopsis: Aural suppuration, followed by a quiescent period, with acute meningeal onset, micro-organisms early present, but in such small numbers as to be overlooked by one competent pathologist. Periods of recession.

History: Two years previously had discharge from ears off and on, but otherwise well. Following an attack of measles had adenoids and tonsils removed. Following tonsil operation child again developed a running ear: apparently doing well for about two weeks, when, on the night of February 23, she suddenly complained of severe pain in the head and vomited. Temperature rapidly rose to 104°. Lumbar puncture; fluid clear, under pressure. The pathologist, Dr. B. F. Cline, reported that pneumococci were present in the cerebro-spinal fluid, he having located them after a careful search of two hours.

With this history, there being no tenderness over the mastoid, a pneumococcus meningitis was diagnosed. The child was taken to the hospital for subarachnoid irrigation. Upon arrival at hospital another lumbar puncture was performed. The hospital pathologist reported that there were no micro-organisms present, and that in his opinion it was a protective type of meningitis. The child had now been sick less than twenty-four hours. Her temperature was high, she had a rapid pulse, was complaining of severe headache and was vomiting, but she did not appear very sick. Blood culture was negative; leucocytes, 19,000; hemiglobin, 60-70 per cent.

Operation: Mastoid freely opened and nothing of importance found. Two trephined holes were drilled in frontal region, but on receiving the

*1. Dandy, W. E., and Blackfan, K. D.: Internal Hydrocephalus. An Experimental Clinical and Pathological Study; *American Journal Diseases of Children*, 1914, 8, 406.

2. Dandy, W. E., and Blackfan, K. D.: Internal Hydrocephalus. Second Paper; *American Journal Diseases of Children*, December, 1917, Vol. XIV, pp. 424-443.

3. Dandy, W. E.: Experimental Hydrocephalus; *Annals of Surgery*, August, 1919.

4. Dandy, W. E.: The Diagnosis and Treatment of Hydrocephalus Due to Occlusion of the Foramina of Magendie and Luschka; *Surgery, Gynecology and Obstetrics*, February, 1921, pp. 112-124.

pathologist's report it was decided not to irrigate, especially as the child appeared to be in excellent condition.

Following the operation the child appeared better, but the temperature continued high. That night, for the first time, she was slightly delirious.

February 24 (the following day): Child vomited several times. Complained of some headache, but passed a very restful day and on the whole looked much better, although temperature still continued high and pulse fast.

February 26: Passed a restless day, sleeping at intervals. During the day the child again vomited several times. Lumbar puncture performed; this being the third lumbar puncture, for the first time the fluid was found to be cloudy; under slight pressure; globulin increased; Fehling's solution reduced normally. The smears showed the presence of Gram positive diplococci. Cell count 2766 per cm. Cultures of fluid demonstrated pneumococci.

February 27: Was slightly delirious at times. Child, however, looked well and parents decided to remove it to its home, where it continued for two weeks, at times better and again worse, and at last died as the result of the meningitis.

Comment: A mistake was made in not acting on the examination of Dr. Cline, who reported finding pneumococci after two hours' search, for at this time the process undoubtedly was very early, as shown by the clear fluid and the low cell count with but few micro-organisms. Also, the history was so positive that we predicted a fatal termination. With such data, we should have washed out the subarachnoid space. The fact that the child lived for two weeks after the onset of the meningitis shows that it might have been possible to control the infection at this time. This child really died, not so much of the meningitis as of the associated septicemia.

II—(b)—*Sub-Acute, or Chronic Exudation Type**—a much less common type, in which the bacteria, having invaded the sub-arachnoid spaces, are temporarily or permanently overcome by the protective meningeal mechanism. Experimental evidence has demonstrated, however, that the invading bacteria may take refuge in the arachnoid recesses around the nerves and blood vessels, from which lodging place they are capable of causing slow death by blood-stream infection, or of suddenly producing an acute exudative or fulminating meningitis.

*Forbes, J. G.: Diplococcus Crassus and Meningitis Associated with a case of Fracture of the Skull. With References; *Lancet*, Oct. 2, 1920, p. 690.

Case III. Fulminating Meningitis from Recrudescence by Exposure and Vaccine Treatment of a Previous Meningeal Infection.

Male; Adult: The previous history revealed in 1915 an infection of the ear followed by coma, with a sterile cerebro-spinal fluid. A left-sided mastoid operation was performed and the dura incised. Following this operation the cerebral symptoms disappeared to a large extent, but six weeks later an extra-dural abscess was located over the cerebellum. This was evacuated and the patient made an uneventful recovery, the wound healed and he had no further symptoms.

He complained of a general malaise following his last injection of triple typhoid vaccine on Oct. 18, 1917. On Oct. 20 he had a full feeling in the left ear. On Oct. 21 he visited Dr. Blair Sutphen, who removed a small quantity of cerumen from the left external auditory canal. Dr. Sutphen stated at this time the patient was slightly tender in front of the left ear. He was of the opinion that the patient was developing a furuncle of external canal. The patient's hearing at this time was very good; there was no dizziness, no headache, no tenderness or redness over the old scar.

On the afternoon of Oct. 21, the patient felt well but in the afternoon traveled by automobile and was exposed to cold and dampness. During the night the left ear began to discharge. Oct. 22 consulted Dr. C. H. Schlichter and myself. Temperature 101°. Patient did not appear sick; no tenderness over the mastoid. On going home patient felt chilly and after reaching home had a slight chill. Was seen by Dr. Sutphen that night (Oct. 22, 1917). Rales found over the base of the right lung. Patient complained of a slight cough and said his head hurt when he coughed. Temperature 102° F. Patient appeared slightly drowsy, although no importance was attached to this symptom at that time.

The following morning (Oct. 23, 1917) patient was markedly drowsy; hearing was good; temperature 104° F. Dr. Thatcher was called and double pneumonia diagnosed, the cerebral symptoms being ascribed to the pneumonia.

Patient had a fairly good day. That night had some rhythmic movements of his right hand. At 5 o'clock a. m. Wednesday, Oct. 24, suddenly had a convulsion, which was followed by others of greater severity as the day went on.

When seen by me Oct. 24 he was in deep coma; flaccidity of right arm and leg; no Babinski on the right; rigidity of the neck; convergent strabismus of the right eye; left optic disc was red and the veins full; pupils small; right fundus not seen on account of small pupil and poor illumination; pulse ranged from 98 to 130; temperature between 102 and 104° F.; ear did not show much discharge, and there was no tenderness or redness over the site of the old operation. A lumbar puncture

showed flocculent spinal fluid, not under great tension, the examination of which showed pneumococci in large numbers; 2000 cells to each field. Blood count 29,000 white cells. Death in deep coma on the following morning.

Comment: There is little doubt in my opinion that the terminal pneumococcic infection was a recrudescence of the original infection from the vaccine treatment and exposure, although I am willing to admit this must be more or less speculative. Still, while in the service, I witnessed so many cases of recrudescence of latent infection from vaccine treatment that to my mind the evidence warrants the placing of the above case in this group.

II—(c) *Local Exudative Type*: Of course it is possible to have a localized exudation into the subarachnoid spaces, but this generally follows by direct extension from an adjacent focus of suppuration, as an intra-piarachnoid abscess located around the internal auditory meatus from involvement of the labyrinth, or over the tegmen by direct extension from the middle ear. An intra-piarachnoid abscess, however, is generally the result of the protective meningitis becoming infected from the adjacent focus of infection and is but very rarely the result of *localization of a general meningeal infection.*

III. *Protective Meningitis*—pure and simple—pathologically characterized by exudation in the subarachnoid spaces, which exudate, however, is *sterile*. In this type the clinical cerebral manifestations are the result of increased production of cerebro-spinal fluid and of blocking the pathways of the cerebro-spinal fluid system in the effort of the protective meningeal mechanism to prevent the infection of the subarachnoid space from a neighboring bacterial or toxic irritant.

The protective type may be (a), local—(a very frequent occurrence)—or (b), general.

The clinical symptoms of a simple protective meningitis—a "sympathetic meningitis"—may be of the severest kind, toxic and compressive, with high temperature, delirium, coma, or convulsions, and aphasia. Lumbar puncture in the general type reveals a cloudy sterile fluid, a very high cell count, an increase in the globulin content, the Fehling reducing agent continuing present however; while in the local

type the fluid—though increased in amount—may be clear and without a high cell count.

If the exciting cause of the protective meningitis is an adjacent focus of infection in the ear or nose, its removal by operation before the actual invasion of the subarachnoid spaces by bacteria has occurred will immediately be followed by a disappearance of all the symptoms; especially if associated with an evacuation of the localized, contiguous mass of cerebro-spinal fluid; but if the localized collection of cerebro-spinal fluid becomes infected—from a direct extension of the suppurative process—an intra-piarachnoid abscess follows.

In an examination of all the cases of suppurative meningitis I am impressed with the number of cases so classified which in reality are but localized piarachnoid collections of pus (from labyrinthitis, necrosis of dura, or brain abscess) with a complicating general protective meningitis, as shown by the absence of micro-organisms in the cerebro-spinal fluid obtained by lumbar puncture. Of course, with the evacuation of the localized irritant, combined with frequent lumbar punctures, the fluid rapidly clears.

The majority, if not all, of the cases of Käding (cases 1 and 2), Emerson, Witzel, Schlesinger, Lucae, Kümmell (1905), Jansen and Day (case 2), although recorded as recoveries from suppurative meningitis, probably belong to this group.*

*1. Käding, K.: Ueber einige Fälle eitriger und epidemischer Meningitis; *Medizin. Klinik*, 1920, Vol. XVI, No. 39, p. 999. (Case I—of four-year-old boy, was a protective meningitis, pure and simple, occasioned by an injury three months previously; cured by repeated lumbar punctures; Case II—of five year-old child, likewise was a protective meningitis of unknown origin, as neither contained micro-organisms but a large amount of turbid cerebro-spinal fluid with leucocytes—a complete picture of protective mechanism.)

2. Emerson, F. P.: Temporo-Sphenoidal Abscess with Meningeal Symptoms. Drainage through the Cisterna Magna; Mastoid Operation; Recovery; *Journal American Medical Association*, 1913, Vol. LXI, p. 1209.

(Report of a cured meningitis with an associated brain abscess; does not, as the author admits, contain sufficient evidence of the actual invasion of the general cerebro-spinal fluid circulatory system to warrant including in the group of suppurative meningitis. It probably was a case of protective meningitis, pure and simple, complicating a brain abscess, as there is no positive record of micro-organisms in the cerebro-spinal fluid.)

3. Witzel, C.. Die operative Behandlung der phlegmoniösen Meningitis; *Mittlg. a. d. Grenzgeb. d. Med. u. Chir.*, 1901, Vol. VIII, p. 388. (Case—with meningeal symptoms following fracture of skull. It was undoubtedly a protective meningitis, pure and simple, no mention of micro-organisms being made.)

4. Schlesinger, A.; Operative Behandlung traumatischer meningitis; Berliner *Klin, Wochenschrift*, 1907, Vol. XLIV, p. 1514. (Case—meningitis following a fracture of the skull. Undoubtedly a case of protective meningitis, pure and simple, no mention being made of the presence of micro-organisms in the fluid. It complicated an intra-piarachnoid abscess of the brain.)

5. Lucae, A. Operative Heilung eines Fälles von ottitischer Meningitis purulenta; *Berliner Klin. Wochenschrift*, 1899, Vol. XXXVI, No. 23, p. 497. (This case probably was a localized intra-piarachnoid abscess. There is no evidence of general meningeal infection.)

6. Kümmell, H.: Die operative Behandlung der eitrigen Meningitis; *Archiv für Klin. Chirurgie*, 1905, Vol. LXXVII, p. 30. (This case was of the protective

type, pure and simple, as the author admits that "no cultures grew from a smear preparation.")

7. Jansen, A. Otitische eiterige Entzündung der Hirnhäute am linken Schläfenlappen, mit Ausgang in Heilung; *Berliner Klin. Wochenschrift*, 1895 Vol. XXXII, No. 35, p. 763. (Report contains no positive evidence of infection of the general cerebro-spinal fluid circulation. The meningeal symptoms which developed subsequently to the operation probably were a post-operative protective reaction.)

8. Day, Ewing W.: Report of Eight Cases of Purulent Meningitis Operated Upon by the Haines' Method. Post Mortem Findings; *The Laryngoscope*, November, 1913.

Case IV. Case of Generalized Protective Meningitis, Originating from Labyrinthine Suppuration, with Symptoms of General Suppurative Meningitis—High Temperature, Headache, Stiff Neck, Kernig, Cloudy Spinal Fluid, Increased Globulin, but Without Micro-Organisms, the Sugar Content Remaining Present—Absolute Disappearance of all Symptoms on Discharge of Small Sequestra of Cochlea.

J. G.; Male; Adult: Seen with Dr. S. H. Baldwin, November 24.

History: Had had discharging right ear for three months. For last three weeks had pain in right ear with severe pain in head, in right temporal region, and dizziness. The night before, slight facial paralysis.

Examination: Right drum membrane destroyed; granulations and pus in external canal. No hearing in right ear.

Rotating to Right: Horizontal nystagmus to left of 9 sec. No dizziness or nausea. Wide deviation of right to right (10 inches). Slight deviation of left to right (3 inches).

Rotating to Left: Horizontal nystagmus to right of 5 seconds. No dizziness or nausea. No deviation of either hand.

Cold Caloric in Left: Produced no nystagmus—if any it was horizontal to left; no pointing deviation of either hand; no dizziness or nausea.

Throwing Head Back: Produced a violent horizontal nystagmus to right; quick movement and large amplitude; wide pointing deviation of both hands to left; dizziness.

Head Forward, Rotating to Right: On straightening up, fell to right; dizziness and nausea.

Head Forward—Rotating to Left: Did not fall; very slight dizziness.

Temperature, 99°; Pulse, 76.

November 27: Lumbar puncture performed; fluid clear, under pressure. Globulin increased. Fehling's slightly reduced. Cell count 100 cm. No organisms.

November 28: Lumbar puncture; fluid clear, under pressure; globulin increased; sugar reduction not normal; no organisms.

November 29: Operation: Labyrinth opened; fistula found; granulations. Posterior fossa opened behind posterior pyramid; quantity of

cloudy cerebro-spinal fluid evacuated. Following operation patient had severe pain over left eye; numbness of fingers of left hand; was restless at night; temperature 101-103°; Leucocytes count 12,800; Polynuclears 73%.

December 3: Stiff neck; severe pain in head; Leucocytes count 16,400, Polynuclears 85%. Smear from wound: Staphylococcus, streptococcus mucosus capsulation Gram +1 bacilli. Temperature 102-104°. Pulse, *slow,* 82-90.

From December 3 to December 28 patient continued with restlessness at night, slightly delirious with alternating attacks of stupor from which he could easily be aroused; severe pain in the head; stiffness of neck; Kernig; pain behind left eye; photophobia, with a continuously high temperature—101-105°—and a proportionally slow pulse. Several blood cultures were negative. Leucocytosis.

December 26: Lumbar puncture; no pressure; color *pale yellow;* globulin greatly increased; sugar reduction about one-half normal; cell count 633 cm.

December 31: Patient seemed better in every way. Temperature 99-101°.

January 7, 1920: Patient looked very sick; pulse very fast and of poor quality, but he rested better at night. Still complained of stiffness in back and legs, but head felt better.

January 18: Patient much better in every way; temperature normal.

February 21: Patient discharged from hospital feeling fairly well, but with a discharging ear. A few days later he discharged a sequestra of cochlea, after which the ear promptly healed and all symptoms disappeared.

A similar case, with dead labyrinth, high temperature, delirium, almost maniacal headache, double papilloedema, cloudy spinal fluid, with cell count of over 3000 but without micro-organisms, an exenteration of the labyrinth, with incision of the dura, was promptly followed by recovery.

Case V. Case of Localized Protective Meningitis, Result of Adjacent, Quiescent Abscess in Petrous Pyramid—with Healed Mastoid Wound and Middle Ear.

Boy; referred by Dr. A. G. Howe, Brooklyn, February 4th.

History: His tonsils were removed about five years ago. He had always complained of aching or weakness in his legs. For the past few years he has had earache in winter; the mother is not sure which ear was affected, but thinks it was the same ear which is now troubling him—the right ear. There was no discharge in the beginning, the ear apparently being dry. Last winter a physician punctured

the ear—no discharge until a similar puncture this year by Dr. Howe; the ear then discharged, and as the pain did not cease Dr. Howe performed a mastoid operation.

Boy was very restless at night before his operation. Following the operation he was very much better for several days. Then he had two chills, not very marked, however. Since then he has not seemed well; he has constant headache and a marked tendency to sleep. The mastoid wound is entirely healed.

February 1: Boy complained of pain over and through the right eye; felt very weak and drowsy; did not want to eat because he had "a full feeling in his stomach and does not want to eat"; said his legs or knees hurt and felt weak if he tried to walk. If he looked at anything for a while his eyes hurt, but he thought he saw well. His temperature was not above 100° since mastoid operation.

Outstanding Symptoms: Severe headaches—right frontal—very severe at night, following mastoid operation three weeks ago. Drowsiness, weakness, aching in legs, aching of right eye, especially when he fixed it.

Examination: The boy looked sick and had a tendency to hold his head forward. The left pupil slightly larger than the right, but this might be because drops were put in while he was in the hospital. Ophthalmoscopic examination showed veins in left eye slightly larger than in right, and both slightly congested. Both vision—20/20.

Hearing:—	Right Ear:	Left Ear:
	Watch—one foot;	Watch—five feet;
	Whisper—across room;	Whisper—across room;
	Voice—across room.	Voice—across room.
Vestibular Reactions:—	No spontaneous past-pointing;	
	No spontaneous nystagmus.	
Rotating to Right:—	Horizontal nystagmus to left of 24 sec.;	
	Dizziness; no nausea;	
	Wide deviation of both to right.	
Rotating to Left:—	Horizontal nystagmus to right of 19 sec.;	
	Dizziness; no nausea;	
	No deviation of either hand.	
Cold Caloric; Right:—		
Right Ear		
(Affected side) Head erect;	Nystagmus to left—good amplitude;	
	Deviation of both to right;	
	Dizziness; no nausea.	
Head back;	Nystagmus to left;	
	Wide deviation of both to right;	
	No increase of dizziness; no nausea.	

Left Ear
(Good ear) Head erect; Slight horizontal nystagmus with rotary tendency to right;
No deviation of either;
Dizziness; nausea.

Urine, 1032; no sugar; no albumen.

February 5: Lumbar puncture, Spinal fluid, amount 3 cc.; fluid bloody; globulin slightly increased; sugar normal; no organisms in smear; culture negative after 48 hours; no cell count owing to presence of blood.

February 5th to 10th: Temperature ranged from normal to 102.2°; pulse.

Impression: "Patient must have either an extra-dural abscess, an intra-dural abscess, or serous meningitis. I do not think it can be sinus thrombosis. It looks like an intra-dural abscess; but not in the cerebellum. It must be in the temporosphenoidal lobe."

Operation: February 10: Incision directly above the ear, through the temporal muscle and fascia; rongeured away the bone; saw the posterior branch of the middle meningeal. Just above this made a nick in the dura; a large quantity of cerebro-spinal fluid evacuated, which apparently was clear and under tension. Exploration within the substance of the brain failed to reveal pus. The mastoid wound, which had been closed, was now re-opened, and found to contain, deep in, under the antrum, a pocket of pus. Posterior fossa exposed; middle fossa exposed.

Comments on Case:

There can be no doubt that this boy had a serous meningitis, the result of extra-dural abscess. This would account for the pain behind his eyes; the disproportion of the symptoms since operated on in Brooklyn; his severe symptoms; and also for his not having cerebro-spinal fluid under pressure at lumbar puncture, the serous meningitis being local in character.

Value of an Existent Protective Meningitis at Time of Bacterial Invasion of Cerebro-Spinal Fluid System.

Even when the general sub-arachnoid space has actually become involved in the bacterial invasion, as in meningitis following the evacuation of a brain abscess—the infection of the general subarachnoid space being shown by the presence of bacteria free within the cerebro-spinal fluid—*if the protective forces of the meninges have been previously fully marshalled*, the infection may still be limited providing drain-

age of the infected area is established. (See Case IX, at the end of this article.)

Of prime importance in the treatment of meningitis is the realization that all four types pass freely from one to another. The hope of attacking the problem scientifically lies in an attempt at a correct differentiation, and in the adoption of measures to combat the pathological condition present at the moment.

It is a clinical fact of consequence, and one to which attention previously has not been directed, that the presence of a protective meningitis induced by a suppurative process within the cerebral substance itself (such as a brain abscess, or suppuration within an adjacent structure in communication with the subarachnoid space—as a suppurative labyrinthitis), by gangrene of the dura or by an intra-piarachnoid abscess, is the chief factor in the cure of a generalized suppurative meningitis, evidenced by the presence of free micro-organisms in the cerebro-spinal fluid. And an examination of the recorded recoveries from a general suppurative meningitis—exclusive of those of meningococcic origin—demonstrates that in fully two-thirds of the cases which have recovered there was present a protective localized meningitis already in action *at the time of the general invasion* of the subarachnoid spaces by the infecting micro-organisms, the pathological processes found at operation being such as necessarily are associated with a previous protective meningeal inflammation.

Indications for the Selection of Individual Methods of Treatment.

What then, we must ask, are the indications for treatment, and what the therapeutic means at our disposal? First, it must be recognized that no *one* therapeutic agent or operation will solve the problem of meningitis. Hope lies in the application of the proper therapeutic agent to the *individual case* at the *specific moment*. For a measure such as irrigation of the subarachnoid space which at one moment may be of avail by removing the cause of infection, subsequently may

become impossible because of the filling of the spaces, or valueless because of the extension of the infection into the ventricles.

Pathological Factors to Be Considered: Four factors enter into the consideration of treatment:

(1)—The virulence of the micro-organism when implanted in the subarachnoid spaces.

(2)—The protective reaction of the tissues of the subarachnoid spaces to the invading irritant.

(3)—The effect upon the brain of closure of the cerebro-spinal fluid circulatory system—(a), by interfering with its proper nutrition, and (b), by causing compression.

(4)—The effect of the infection on the general vascular circulation by the emptying of its bacteria and toxemia into it.

If the virulence of the infecting organism in the tissues of the subarachnoid space is low, and the protective tissue reaction prompt, as is the case in epidemic cerebro-spinal meningitis, recovery may follow, either spontaneously, or after the injection of a specific serum (meningococcic)—which doubtless assists not only by killing the micro-organism, but also by stimulating the protective reactive mechanism.

With a high degree of virulence and a poor protective tissue reaction the prognosis necessarily must be unfavorable. Subarachnoid irrigation, however, would logically appear to hold out some hope for recovery, by removing the bacteria and exudate and stimulating the protective reactive forces.*

If, however, the protective reactions of the meninges have already been well established at the time of the infection—as in meningitis following brain abscess, necrosis of the dura, labyrinthitis, and so on—the prognosis is far from hopeless; especially if the surgeon drains the original source of infection. In addition to this, I believe the pathological condition within the cerebro-spinal circulatory system calls for

*Note. It is undoubtedly the stimulation of the protective reactive forces of the cerebro-spinal fluid system through multiplication and phagocytic reaction of the cells of the arachnoid and pia by the injection of a foreign proteid —a serum—which has resulted in the reported cures of suppurative meningitis by serums without operation. (Du Bois, Phebe L. and Neal, Josephine B.: Streptococcus Meningitis with Report of a Cured Case: *Archives of Pediatrics*, January, 1915).

subarachnoid irrigation to remove the infecting micro-organisms, to keep open the cerebro-spinal fluid pathways, and further to stimulate the protective meningeal reactions.

Treatment:

(1)—Eradicate or drain known foci of infection, such as a mastoid, nasal accessory sinus, or bony cranial involvement, an extra-dural abscess, a sinus thrombosis or labyrinthitis, an intra-cerebral abscess, an intra-piarachnoid abscess, or a localized piarachnoid collection of cerebro-spinal fluid;

(2)—Free the pathways of the cerebro-spinal fluid circulatory system by subarachnoid drainage, thus partly, at least, removing the micro-organisms and exudates, and attempting to prevent occlusions of the foramina of Luschka and Magendie, and extension into the ventricles, with associated cerebral compression;

(3)—Encourage the development of the protective reactions of the meningeal mechanism by the injection of non-toxic serums into the subarachnoid spaces;

(4)—Combat general blood-stream sepsis by Murphy drip, diuresis, diet, et cetera;

(5)—Finally, control cerebral compression when present.

Relative Importance of Therapeutic Measures.

Logically and clinically, from an examination of the recorded cases of recovery from suppurative meningitis previously mentioned, the most important indication is the evacuation of any causative localized intra-dural focus of suppuration—an intra-cerebral or intra-piarachnoid abscess, labyrinthitis, or infection from a bony trauma. (See Case VIII, end of this article).

In the presence of such a lesion the number of recorded recoveries is so few—only twenty-two in all literature in spite of the large number of operations performed—that I am of the opinion that subarachnoid irrigation should immediately be instituted. In the absence of a localized focus of infection, either within or connected with the dura, the clinical evidence of the few recorded cases of recovery in this type of the disease—only eight in the literature in spite of the im-

mense number of operations, would compel us, I think, to regard the usual operative procedure for drainage as not warranted; especially so as, in addition to the clinical evidence, the post mortems of Day* have demonstrated that drainage operations are pathologically inadequate to control the disease.

In those cases, then, in which there is no demonstrable diagnostic or operable lesion within the brain or directly involving the subarachnoid spaces, subarachnoid irrigation should be instituted at the earliest possible moment, since, up to the present, this holds out the only logical hope of recovery.

An understanding of the subject will be assisted by a study of the relative frequency of the paths of infection in otitic meningitis as found "either on clinical or on operative examination, or on the basis of autopsy findings," as reported by Berggren,** (90 cases) and Mygind (35 cases).

	Berggren	Mygind	Total	
Labyrinth	27	11	38	30%
Sinus Phlebitis	28	6	34	27.2%
Pachy-meningitis (with or without brain abscess)	15	2	17	13.5%
Through Osteitic Changes (Vault)	4	7	11	88%
Untraceable	16	9	25	20%
	90	35	125	

If we combine the statistics of Berggren and Mygind, we have 125 cases, in which, in 100—or 80%—a path of infection was traceable and in 25—or 20%—the path of infection was untraceable. Judging from this, in otitic suppurative meningitis, an operation which attacks the original source of infection is indicated in about 80% of the cases.

Types of Meningitis Calling for Subarachnoid Irrigation:

It is to be remembered that many cases of pneumococcus meningitis of aural origin clinically present but few symp-

*Day's post mortem observations are that "drainage of the cisterna magna hinders the development of meningitis over the hemispheres, but appears to have no effect upon the accumulation of pus in the piarachnoid, and does not influence the progress of the infection at the base of the brain."—"The accumulations here were present in all of our post mortems, extending from the optic commissure, over the medulla and the upper anterior portion of the spinal cord."—*Laryngoscope*, November, 1913.

**Berggren, Sture: Etudes sur la méningite otogene purulente généralisée principalement en ce qui concerne le traitement opératoire; *Acta Oto-Laryngologica* 1921, Supplement 1.

toms for a considerable period of time after the appearance of micro-organisms in the cerebro-spinal fluid—a feeling of "not well," with more or less headache, being the only complaint.*[1]

As all of these cases, up to the present, have ended fatally, it would seem to me that irrigation of the sub-arachnoid spaces is especially indicated, as this method logically holds out a possibility of cure by eliminating a part of the infection, keeping open the cerebro-spinal fluid pathways by stimulating the meningeal protective mechanism—which, for some unaccountable reason, appears more or less quiescent; the more so as the end frequently comes suddenly, life ceasing because its "governing, controlling, and correlating centers are entirely prevented from continuing their functional activity,"** possibly from a blocking of the cerebro-spinal fluid circulatory system.

Again, as previously described, the pathological picture of human fulminating pneumococcus meningitis, type III, is so similar to that seen in experimentally induced fulminating meningitis from blood-stream infection—punctate hemorrhages in the piarachnoid, followed by an exudation at first confined to the spaces over the cortex—that one is forced to regard it as identical; *excepting that in man the aural or nasal suppuration precedes the meningeal involvement.*

If the contention made in this paper be true, that the human type of fulminating meningitis is at first strictly a local process—the sudden meningeal involvement being possibly a combination of a local blood-stream infection, plus a disturbance of the meningeal protective mechanism, and *later* a general blood-stream infection—then this type offers a possibility of cure by early lavage of the subarachnoid spaces. Especially so as clinical experience has demonstrated that in

*Berens, T. Passmore: Report of Two Cases of Cerebro Spinal Meningitis Presenting No Central Nervous Phenomena Until Shortly Before Death; *Transactions American Otological Society*, 1913, Vol. 13, p. 59.
Day, Ewing W.: Discussion; *Transactions American Otological Soc.* 1913, Vol. 13, p. 88.
Kopetsky, Samuel J.: Operative Treatment of Meningitis; *Laryngoscope*, 1914, Vol. 24, p. 733.

**Ayer, J. B.: Experimental Acute Hematogenous Meningitis; Monographs of *Rockefeller Institute for Medical Research*, March 25, 1920, No. 12, p. 119.

the early stages but few bacteria are obtainable from the cerebro-spinal fluid, and experimentally it has been demonstrated that at this time the infection is limited to the subarachnoid spaces of the cortex.

The inferred therapeutic indications, then, in the fulminating type of suppurative meningitis—pneumococcus meningitis—would be the early removal of the bacteria and the stimulation of the protective meningeal mechanism *before the invasion of the ventricles.* In the acute, sub-acute and chronic exudative types—streptococcic and meningococcic—the same course should be pursued to prevent the exudate from filling the subarachnoid spaces, causing obliteration of the perivascular spaces and extension into the ventricles.

Cerebral and Cerebro-Spinal Subarachnoid Irrigation:

Historical and Clinical: Roth, in 1893, suggested irrigation of the subarachnoid spaces, from the Sylvian region to the occipital regions of the base with boric acid solution.*1 Barr experimentally demonstrated that frequently fluid irrigated into the lateral ventricles would be recovered from the lumbar region, and in its course permeate the subarachnoid spaces of the cortex and the basal cisterna. He also practiced irrigation of salt solution on a patient in extremis, the patient living fourteen hours*2.

Following the suggestion of Barr, Day unsuccessfully attempted to irrigate through the ventricle into the lumbar region. He also washed out the spinal canal with normal salt solution passed from a canula into the lumbar region through an operative opening in the cisterna magnum*3.

Cushing demonstrates that normal salt solution without a calcium content had a toxic influence on the cerebral tissues*4.

Wegeforth and Essick, and Weed and Wegeforth first experimentally demonstrated the lethal action of all antiseptics. When *irrigated through* the subarachnoid space even sterile, distilled water is highly toxic, while a saline solution without a proper proportion of calcium frequently was followed by a fatal respiratory or circulatory embarrassment. Later

*1. Roth, C. E.: Operative Treatment of Cerebro-Spinal Meninginitis and Traumatic, Intra-cranial Lesions without Fracture; *American Journal of Surgery and Gynecology*, 1893-94, Vol. IV, p. 23.

*2. Barr, Stoddart: Experiment Bearing Upon the Practibility of Treating Meningitis by Means of Lavage of the Cerebro-Spinal Sub-Arachnoid Spaces; *British Medical Journal*, November 26, 1910, Vol. II, p. 1617.

*3. Day, Ewing W.: Report of Eight Cases of Purulent Meningitis Operated upon by Haines' Method. Post-Mortem Findings. *Laryngoscope*, November, 1913.

*4. Cushing, Harvey. *American Journal of Physiology*, 1902, Vol. VI, p. 77.

they demonstrated that a properly balanced, modified Ringer's solution may be passed through the subarachnoid space with safety*1.

It is to be understood that *irrigation of* and *injection into* the subarachnoid spaces are fundamentally different. Injections limited in extent may not be lethal, because of the limited degree of toxemia which they may cause Irrigation fluids to be safe must be balanced to a nicety as to composition, and approximately of the body temperature.

It would seem that the early experiments of Falkenheim and Nauryn*2 and L. Hill*3 did not have a lethal effect because they simply injected sodium chloride solution and did not irrigate it through the spaces. França*4 and Wolff*5 both partially irrigated the *spinal canal* with lysol and proto-argol in meningococcus meningitis, the latter reporting five cases of recovery, after failure with serum alone. The immunity of the França and Wolff cases from lethal toxic effects was because both of these observers did not, in the true sense, irrigate the subarachnoid space of the spinal cord—they simply injected small quantities of fluid after allowing the flow of cerebro-spinal fluid. França injected lysol into the spinal canal, one needle being in the twelfth dorsal space, the other in the lumbar sacral space; through these he passed the solution of lysol, using in adults from 12-20 cc., and in children, 3-9 cc.; while Wolff injected 10 cc. of a saline solution into the lumbar region. The method of França and Wolff is spinal *injection*. Cerebral or cerebro-spinal *irrigation* of such toxic substances would of necessity rapidly be fatal.

A careful review of the recent literature, while disclosing many cases of so-called lavage in epidemic cerebro-spinal meningitis, fails to disclose any of true subarachnoid irrigation.

Thus Farmachides*6 simply injected salt solution into the spinal canal after a lumbar puncture, and repeated the process; and Käding*7 also injected the lumbar sac with fluid, although he called it "lavage."

*1. Wegeforth, P. and Essick, Charles R., and Weed, Lewis H. and Wegeforth, P.: *Loc. Cit.*

*2. Falkenheim, H., and Nauryn, B.: *Archives of Experimental Pathology and Pharmacology*, 1887, Vol. XXII, p. 261.

*3. Hill, Leonard. Physiology and Pathology of the Cerebral Circulation; London, 1896.

*4. França, C.: Sur le traitement chimique des méningitis; *Séances et Mémories de la Société de Biologie*, 1917, Vol. 80, p. 422.

*5. Wolff, G.: Der Versuch einer neuen Meningitisbehandlung mit Siber-Sub-Arachnoid Space; Reprint; from *Journal of Pharmacology and Experimental Therapeutics*, July, 1919, Vol. XIII, p. 329.

*6. Farmachides: Lavage of Spinal Cavity in Epidemic Meningitis; *Gaz. digli Ospedali e delle Cliniche, Mila.* Nov. 13, 1919, Vol. 40, No. 91, p. 988.

*7. Käding, K.: Ueber einige Fälle von geheilter eiteriger and epidemischer Meningitis; *Medizinischer Klinik*, 1920, Vol. XVI, No. 39, p. 1007.

EFFECT OF CEREBRO-SPINAL SUBARACHNOID IRRIGATION OF A "PROPERLY BALANCED PHYSIOLOGICAL SOLUTION" ON THE CHEMICAL COMPOSITION OF CEREBRO-SPINAL FLUID:

Weed and Wegeforth*1 experimentally demonstrated that the "sodium chloride and the globulin content and gold reaction were unaffected after irrigation with a properly balanced plupio-logical solution thus showing absence of irritation. However, irrigation with any antiseptic solution, even in great dilution, was followed by enormous increase in the cell count. This persisted from five to six days, according to Wegeforth and Essick*2, at the end of which time, although the cerebro-spinal fluid showed a return to normalcy, the animal became worse.

Extent of Area Involved in Irrigation:

Barr*3 and Weed and Wegeforth*4 found experimentally that a cerebral subarachnoid irrigation of a pigment was followed by the uniform distribution of the pigment over the major part of the homolateral hemisphere, the contra-lateral hemisphere being covered about two-thirds, and *the basal cisterna filled;* also they found "that spinal irrigation resulted in the whole spinal arachnoid space being pigmented, and this extended into the basal cisterna." This experimental evidence coincides with my own clinical experience—that the removal of the waste material lessens the toxemia, although it may not completely control the infection.

In the Weed and Wegeforth*5 experiments in cerebral and spinal irrigation two of the animals with experimentally induced meningitis recovered, and the prolongation of life in all so treated was apparent. In those that did not recover the "washing away of some of the toxic products of bacterial growth seemed also of service, for the irrigated animal was usually more nearly normal for the next six hours than the controls." In these experiments multiple irrigation was not attempted, which my experience with Case VI would make me think absolutely essential.

Operative Technic:

Incision of the dura may simply open the sub-dural space; but the in-flow canula must be introduced *into the subarachnoid spaces,* as otherwise the irrigation merely may distend the

*1. Weed, Lewis H., and Wegeforth, Paul: Experimental Irrigation of the Subarachnoid Space; Reprint; from *Journal of Pharmacology and Experimental Therapeutics,* July 1919, Vol. XIII.

*2 Wegeforth, Paul, and Essick, Charles R.: Effect of Subarachnoid Injections of Anti-Septics Upon the Central Nervous System; Reprint, from *Journal of Pharmacology and Experimental Therapeutics,* July, 1919, Vol. XIII, p. 337.

*3. Barr, Stoddart: Loc. Cit.

*4. Weed, Lewis H. and Wegeforth, Paul: Experimental Irrigation of the Subarachnoid Space; Reprint from *Journal of Pharmacology and Experimental Therapeutics,* July, 1919, Vol. XIII, p. 320.

*5. Weed, Lewis H., and Wegeforth, Paul: Experimental Irrigation of the Subarachnoid Space; Reprint, from *Journal of Pharmacology and Experimental Therapeutics,* July, 1919, Vol. XIII, p. 330.

sub-dural space and have no effect—a condition which probably occurred in one of my irrigations. Another graduated needle of rather large bore is introduced into the cerebello-medullary cisterna—following the occipito-atlantal puncture technic of Ayer—and recovers the out-flow.

Amount of Fluid: The amount of fluid possible to pass through the cerebral and spinal arachnoid spaces varies. Weed and Wegeforth* state, "In spinal irrigation in normal animals the flow was always slow, and a large amount of fluid was not obtainable at the needle of exit," . . . . "only 106 cc. after one and one-half hours." "In normal animals the time of cerebral irrigation was one hour, and the amount of fluid recovered varied from a few hundred to over one thousand cc."

In the Weed and Wegeforth experiments in infected meninges, cerebral irrigation was undertaken in two to four hours after infection, and from fifty to five hundred cc. irrigated in thirty minutes—that is, about one and three fourths to seventeen cc. per minute. This experimentally demonstrated how the presence of the pathological exudate in the subarachnoid space interferes with the free lavage possible in normal meninges. All of my own cases demonstrate that if this method is to be fully successful it must be undertaken early in the disease.

Speed of Flow: In all of my three cases of cerebral irrigation the flow was somewhat slow, and in the one with a great deal of exudate the exit needle constantly was becoming clogged with shreds, necessitating its frequent cleansing with a stylette. Also, at the point of entrance, distension of the subarachnoid space frequently occurred. Consequently it is suggested that several in-flow openings be made, and that the irrigation, when not free through one, be stopped and another opening be used, as in Case VIII, reported at the end of this paper.

It is evident that the free, continuous stream which can be obtained experimentally in a normal animal** is not possible after the subarachnoid spaces have become the seat of an exudate, and that it is advisable in otitic cases to introduce an exit canula into the lateral cisterna as well as into the occipito-atlantal and lumbar regions, and not, as in my first case, to attempt to irrigate from the lateral cisterna through to the lumbar region. I am persuaded that the larger the number of

*Weed, Lewis H. and Wegeforth, Paul: Loc. cit.
**Weed, Lewis H. and Wegeforth, Paul: Loc. cit.

openings made both for entrance and exit the better the prospect of accomplishing the object*.

Maintenance of Even Temperature: An even temperature of ninety-nine is maintained throughout the operation by an outer water-bath for both container and tubing. In both water-baths a thermometer is kept constantly, and to regulate this the constant attention of an assistant will be required who has had some experience in a chemical laboratory. His sole duty should be (a), to regulate the temperature of the ingoing fluid and (b), to note and record the rate and amount of the in-flow. Another assistant notes and records the rate and amount of the recovered fluid, and at the same time holds the canula in the occipito-atlantal and lumbar regions. The operator himself should place and hold steady the in-take canula within the subarachnoid space.

Conclusions:

Irrigation of the subarachnoid spaces keeps open the tracts for the normal circulation of the cerebro-spinal fluid essential to the removal of waste products from the cerebral tissue substance if not for its actual nutrition. It also, partially, at least, removes the bacteria and exudates produced by the bacterial and toxic reactions of the tissues themselves.

My experience with the three cases reported leads me to assert that cerebral irrigation of the subarachnoid space is a painless proceeding, without great danger if conducted with scrupulous care as to technic: and as an examination of all the recorded cases has demonstrated that suppurative meningitis is almost invariably fatal, I am of the opinion that immediately upon the demonstration by lumbar puncture of micro-organisms—exclusive of the meningococcus group—in the cerebro-spinal fluid, a cerebral and cerebro-spinal subarachnoid irrigation should be instituted.

*. In this respect the observation of Lewkowicz is enlightening. In injecting serum into the ventricle in meningococcic cases, he found that at the first injection only a small amount of the serum would enter because of the blocking of the cerebro-spinal pathways, the serum, however, acting on the exudate which was filling the pathways. Subsequently, however, large quantities of serum may be introduced without difficulty. Lewkowicz, K. Die spezifische Behandlung der epichemischer Genickstarre Intra-Kammerale Seruminjectionen; *Wiener Klinischer Wochenschrift*, 1918, No. 21, p. 578.

Analysis of Thirty-One Collected Cases of Recovery From General Suppurative Meningitis:

In an examination of the literature I can find but thirty cases of recovery from general suppurative meningitis in which the diagnosis was substantiated by the finding of micro-organisms in the cerebro-spinal fluid; these with the one herein recorded case, make a total of thirty-one recoveries from a general suppurative meningitis.

Of the collected cases two are simply referred to by Du Bois and Neal—Summary of Seven Years of Clinical and Laboratory Experience with Meningitis in New York City, *Department of Health Reprint Series*, No. 62, September, 1917—"No patient with pneumococcus meningitis directly under our supervision has recovered, but we know of two patients that did." These two cases consequently can be utilized only in a consideration of the kind of infecting micro-organism from which recovery is possible.

Of the remaining twenty-nine, two—Göbell's and Kümmell's—are very superficially recorded, having been orally reported at a meeting of the Society of North West German Surgeons, and published only in abstract in the *Centralblatt für Chirurgie*, 1909, Vol. XXXVI, No. 34, p. 1179.

Of the remaining twenty-seven, two—Tedesco's and Netter's—are lacking in the details essential to a proper analysis Tedesco—Streptokokken Meningitis durch Lumbalpunktion geheilt; *International Centralblatt für Ohrenheilkunde*, 1910-'11, Vol. IX, p. 365—makes no mention of the cause of the meningitis, and Netter—Méningitis cérébro-spinales suppurées à streptocoques consécutives à la scarlatine; *Bull. et Mém., Soc. Méd. des Hôp. de Paris*, 1909, Vol. XXVII, p. 11—presents his case primarily to demonstrate the value of lumbar puncture, but unfortunately fails to enumerate many details necessary to a complete analysis.

Of the twenty-four cases still to be considered, one—Gradenigo: Ueber die Diagnose und Heilbarkeit der otologischen Leptomeningites; *Archiv. für Ohrenheilkunde*, 1899, Vol. 47, p. 158—in its history, course and outcome warrants the

suspicion that it primarily was a protective meningitis, the micro-organisms found in the cerebro-spinal fluid by puncture being possibly a contamination from the skin; and in one—Held, R. J. and Kopetsky, Samuel J.: Report of a Case of Purulent Meningitis Following Radical Mastoid Operation; Recovery after Operative Interference; *Archives of Otology*, 1906, Vol. XXXV, p. 531—although fully reported and discussed, is not above the suspicion of being a meningococcic infection, which is doubly true of my own case—Case VII—my own being an intra-cellular diplococcus complicating a fracture of the skull, and Held and Kopetsky's a diplococcic meningococcic infection engrafted upon an otitis media with an extra-dural abscess followed later by a mixed infection possibly from contamination during the course of the disease. This suspicion is further justified by the very high cell count —310,000—in the cerebro-spinal fluid; a condition which, although frequent in meningococcus meningitis, is most unusual in the cases of recovery from other types of micro-organism.

Utilizing all the data, then, the analysis must vary between thirty-one and twenty-five cases of general suppurative meningitis which have been cured.

TOTAL NUMBER OF COLLECTED CASES AVAILABLE FOR ANALYSIS—*.

Kausch: Die Behandlung des Hydrocephalus mit Konsequentis. Punction; *Mittheil. aus den Grenzgeb. des Medizin und Chirurgie*, 1910, Vol 21, p. 329, Case III.

Held and Kopetsky: Loc. cit.

Grossman, F.: Kasuistisches zur Lumbalpunktion und Circumscripten Meningitis; *Archiv für Ohrenheilkunde*, 1905, Vol. LXIV, p. 24.

Beck, J. C.: Failures and Successes in Diagnosis and Surgical Intervention of Some Intracranial Diseases, Especially from the Standpoint of an oto-laryngologist, with Report of Cases; *Illinois Medical Journal*, 1913, Vol. XXIV, p. 265.

Bondy—three cases: Zur Frage der Heilbarkeit der otogenen Streptococcen Meningitis; *Wiener Mediziner Wochenschrift*, 1917, Vol. LXVII, p. 1600.

Du Bois, Phebe L. and Neal, Josephine B.: Loc. cit.

*Of the cases listed here those of Netter, Tedesco, Göbell and Kümmell are incompletely reported, and the two cases of Du Bois and Neal are merely referred to

Watson-Williams, P.: Case of Labyrinthitis, Diffuse Purulent Meningitis; Labyrinthotomy; Recovery with Intravenous and Intrathecal Injections of Colloidal Silver; *Journal Laryngology, Rhinology and Otology*, 1920, Vol. 35, p. 197. Also *Trans. Royal Soc. of Medicine; Section of Otology*, 1920, p. 73.

Poirier: Fracture de l' étage antérieu du crâne, méningite consécutive, trépanation double, guérison; *Bulletins et Mémoires de la Société de Chirurgie*, 1901, Vol. XXVII, p. 17.

Alexander, G.: Klinische Studien zur Chirurgie der otogenen Meningitis; *Archiv für Ohrenheilkunde*, 1908, Vol. LXXVI, p. 1

Netter, A.: Loc. cit.

Kostlivy, S.: Die Operation der citerigen Meningitis; *Archiv für Klinischer Chirurgie*, 1912, Vol. 97, p. 627.

Göbell: Loc. cit.

Tedesco: Loc. cit.

Day, Ewing W.—three cases: Indications for and Results of Operative Treatment of Otitic Meningitis; *Surgery, Gynecology and Obstetrics*, April, 1913, pp. 369-376.

Kümmell: Loc. cit.

Litchfield—five cases: Pneumococcus Meningitis: Treatment by a Specific Antipneumococcus Serum; *Journal American Medical Association*, May 10, 1919, p. 1345.

Held, R. J., and Kopetsky, Samuel J.: Loc. cit.

Gradenigo: Loc. cit.

Lewkowicz, K.: Guérison per un vaccin spécifique d'un abscès cérébral et d'une méningite générale à staphylocoques, consécutifs à un coup de feu du crâne; *Archiv de Méd. des Enfants*, 1920, Vol. XXIII, p. 540.

O'Malley, J. F.: Case of Purulent Otitic Meningitis; Operation; Recovery; *Transactions Royal Society of Medicine, February* 20, 1920, p. 72.

Scott, Sydney. Streptococcal Leptomeningitis in a Child due to Chronic Suppurative Otitis Media; Rapid Development of Coma; Radical Mastoid Operation with Translabyrinthine and Lumbar Thecal Drainage with Complete Recovery; *Journal of Laryngology and Otology*, July 1921, Vol. XXXVI, No. 7, p. 356.

Eagleton, Wells P.: See Case VI, at end of paper.

Primary Focus of Infection.

Of the thirty-one collected cases of recovery the primary focus of infection was:

(a)—From an otitis media, twelve cases—Beck, Bondy (three cases), Netter, Du Bois and Neal, Held and Kopetsky, Day (three cases), Gradenigo, and O'Malley.

(b)—From a labyrinthitis following an otitis, four cases—Watson-Williams, Alexander, Grossman, and Scott.

(c)—From a labyrinthitis precipitated by a trauma, one case—Bondy.

(d)—From an otitis precipitated by a trauma, one case—Kostlivy.

(e)—From a perforating trauma of the dura, three cases—Kausch, Poirier, and Lewkowicz.

(f)—From a fracture of the skull, with hemorrhage from the ear and nose, (and consequently may be regarded as compound although the hearing was not destroyed), one case—Eagleton.

(g)—From, or concurrent with a pneumonia, (and consequently may be regarded as of blood-stream origin), five cases—Litchfield.

(h)—Primary focus not stated, four cases — Kümmell, staphylococcus albus; Göbell, staphylococcus aureus; two cases referred to by Du Bois and Neal, pneumococcus.

Protective Inflammation Present Prior to Development of General Meningitis and Acting as Chief Curative Agent.

Twenty-six cases are recorded with sufficient detail to warrant an attempt to analyse the pathological lesion present at the time of the invasion of the general cerebro-spinal fluid system. Of these, five—Litchfield's—or 19%—were undoubtedly of blood-stream origin, the pneumococcus meningitis originating from a pulmonary infection, although frequently the meningeal symptoms at first overshadowed the lung manifestations. The remaining 21 cases—or 81%—include all that were *preceded by* a local infection. Of these twenty-one, the injury or an operation disclosed a *local pathological* process necessarily *associated with a previous protective* meningeal reaction in fourteen, and probably in sixteen cases—or 70% and 80% of all cases of local origin.

Mygind's* well known report of cure in six cases unfortunately cannot be included on account of incompleteness of details, especially as to the presence of micro-organisms in the lumbar puncture fluid; he evidently makes no distinction between general suppurative meningitis

*Mygind, H.: The Operative Treatment of Otitic Meningitis; *Journal American Medical Association*, 1910, Vol. LV, p. 759.

and a protective meningitis. He states, "Bacteria are generally present; when they are absent the prognosis is favorable." The one case fully reported undoubtedly was entirely protective as "the lumbar puncture yielded a very turbid fluid which contained numerous polynuclear cells, but no bacteria."

From the wording of the report all the other five cases presumably were preceded by a protective meningitis, as they all apparently followed brain abscess, sub-dural abscess, labyrinthitis, necrosis of the dura, or sinus thrombosis. These five cases, if included in the analysis, would, of course, considerably increase the proportion of cures of meningitis of local origin in which a protective meningeal reaction was present prior to the invasion by micro-organisms.

Details of Lesion Present in Sixteen Collected Cases of Recovery from General Suppurative Meningitis of Local Origin that Necessarily Were Proceded by a Protective Meningitis Either Local or General.

(a)—Preceded by a localized, intra-dural suppuration; and consequently associated with a more or less general protective meningeal reaction—six cases; of these, two were preceded by a brain abscess, (Day), treated by Haines' operation; one was associated with or preceded by an intra-piarachnoid abscess—otitic—(Held and Kopetsky), treated by drainage; and three were associated with or preceded by a sub-dural, traumatic abscess, (Kostlivy, Poirier, and Lewkowicz), treated by drainage.

(b)—Preceded by a local protective meningitis of local extra dural origin—eight cases; of these, five were preceded by a labyrinthitis—the Bondy case, treated by a labyrinth operation; the Watson-Williams case, also treated by a labyrinth operation the Alexander case, treated by a labyrinth operation and intra-thecal and intra-venous serum; the Grossman case, treated by a radical operation; the Scott case, treated by trans-labyrinthine drainage.*

One case associated with a perforating, infective traumatism, (Kausch), treated by drainage; one, associated with necrosis of the dura, (Bondy, Case II), treated by dural incision;

*Labyrinthitis always is associated with a limiting, protective meningitis around the internal auditory meatus in order to shut off the general subarachnoid space which otherwise would be involved.

and one, following a compound fracture of the skull, (Eagleton), treated by subarachnoid irrigation and intra-spinous injection of meningococcus serum.

(c)—Probably preceded by a protective meningeal reaction—pachymeningitis interna and local piarachnoid exudate—two cases: one, following a sinus thrombosis, (Beck), treated by Haines' operation; the other, showing Gradenigo's syndrome, in which probably there was a local pachymeningitis or a local protective piarachnoid collection of fluid over an infected area of bony caries deep in the petrous pyramid, (Bondy, Case III), treated by a mastoid operation.

In fifteen of these sixteen cases an operation by eradicating or draining the causative, intra-dural irritant may be regarded as the chief, but not the sole factor in the recovery. The operation simply broke the vicious circle and eliminated the causative factor, thus allowing the already active protective meningeal mechanism to combat the micro-organisms which had gained entrance to the cerebro-spinal fluid circulation. In the remaining case, (Eagleton, Case VI), it probably was the removal of the inflammatory exudate from the subarachnoid spaces that allowed the already present meningeal reaction to complete the cure.

The remaining five of the twenty-one cases of local origin all began with an otitis; one reported by Gradenigo,* as previously noted, is not above the suspicion of being a skin contamination; one (Netter), is incompletely reported; in two (Day, and Dubois and Neal), the curative agent may be regarded as the intra-spinous injection of a serum stimulating the protective meningeal reaction; and in one (O'Malley), cure followed a mastoid operation and lumbar puncture.

Probable Curative Agent:

Of the twenty-nine cases of recovery from a general suppurative—non-meningococcus—meningitis, five of blood-stream—pneumococcic—origin (Litchfield), were treated by intra-spinous and intra-venous specific serum—Keyes'. Of the twenty-one of local origin, seventeen were operated and four

*Gradenigo. Heilbarkeit der otitischen Meningitis: *Archiv Für Ohrenheilkunde* 1899, Vol. 47, p. 158. Case III, following an operation on February 18, lumbar puncture showed in the culture, staphylococcus "such as is seen normally." Recovery followed the puncture.

unoperated (Gradenigo, Netter, Day—Case III, and Dubois and Neal). In three cases (Göbell's, Kümmell's, and Tedesco's) the origin was not stated.

The operation apparently was the chief curative agent in the seventeen of the twenty-one cases of local origin (Kausch, Held and Kopetsky, Grossman, Beck, Bondy—three cases, Watson-Williams, Poirier, Alexander, Kostlivy, Göbell, Day—two cases, O'Malley, Scott, and Eagleton). Seven of the twenty-nine (Netter, Kümmell, Tedesco, DuBois and Neal, Gradenigo, Day, and Lewkowicz) were not operated upon after the development of the meningitis, although the last three previously had been subjected to an operation.

In the seventeen cured by operation, the operation consisted of:

(a)—The removal of the intra-dural source of infection, combined with lumbar punctures—eight cases; three, intra-piarachnoid abscess (Held and Kopetsky, Poirier, and Kostlivy), and one, perforating dural wound (Kausch); two of brain abscess (Day), and one, of sinus thrombosis (Beck), were followed by drainage of the cerebro-spinal fluid system—Haines' operation: and one, compound fracture of the skull (Eagleton), by irrigation of the subarachnoid space alone.

(b)—Drainage of the labyrinth and incision of the dura, combined with lumbar punctures—one case (Alexander).

(c)—Drainage of the labyrinth combined with lumbar punctures—three cases (Grossman, Bondy, Case I, and Scott).

(d)—Drainage of the labyrinth, combined with lumbar punctures and intra-venous and the intra-thecal injections of serum—one case (Watson-Williams).

(e)—Removal of adjacent focus of infection (extra-dural abscess) and incision of dura, with lumbar punctures—one case (Bondy, Case II).

(f)—Drainage of adjacent focus of infection, with lumbar punctures—two cases (Bondy, Case III, and O'Malley, mastoid operation).

(g)—Laminectomy—one case (Göbell, unstated origin).

In the seven unoperated cases, apparently the chief curative agent was:

(a)—Lumbar punctures alone in four cases (Gradenigo, Kümmell, Netter, and Tedesco).

(b)—Lumbar punctures with intra-spinous injections of anti-streptococcus serum and vaccines in one case (Day).

(c)—Lumbar punctures with intra-thecal injection of meningococcus serum and intra-venous injection of anti-staphylococcus serum in one (DuBois and Neal).

(d)—Lumbar punctures and sub-cutaneous injections of staphylococcus vaccine prepared from the cerebro-spinal fluid in one (Lewkowicz).

Infecting Micro-organisms:

In the thirty-one recovered cases the infecting micro-organism was:

a)—Pneumococcus in eight (Beck, one case, the two referred to by DuBois and Neal, and Litchfield, five cases).

(b)—Staphylococcus in six (Göbell, Kausch, Poirier, Kümmell, Gradenigo, and Lewkowicz).

(c)—Bacillus Influenza in one, case of brain abscess (Day).

(d) Streptococcus in ten (Tedesco, Netter, DuBois and Neal, Watson-Williams, Alexander, Day, serum treatment, and Day, brain abscess, Bondy, Case II and Case III, and Scott).

(e)—Gram positive in one (Kostlivy).

(f)—Diplococcus in two (Grossman, and Bondy, Case III).

(g)—Diplococcus intercellular, extra-cellular, and mixed, in two (Held and Kopetsky, and O'Malley).

(h)—Diplococcus intercellular and extra-cellular in one (Eagleton, Case VI).

Note 1: *Typhoid Meningitis.* In a compilation by Baumgartner and Olsen of all the cases of typhoid meningitis, no recovery followed.*

Note 2: *Tuberculous Meningitis.* Hollis and Pardee** have collected 38 cases of verified tuberculous meningitis ending in recovery, to which

*Baumgartner and Olsen, Typhoid Meningitis, *Archives of Internal Medicine*, 1920, Vol. XXV, p. 537.

On page 549 of this article the authors refer to the work of Raymond and Siccard, who report two cases of localized tubercular meningitis—not general—from a local adjacent infection.

Raymond, F., and Siccard, J. A.: Epidurite purulente lombaire à bacillus d'Eberth dans la convalescence d'une fièvre typhoide. Paraplégie. Ponction lombaire; *Bull. et Mèm. Soc. Méd. d. Hôp. de Paris*, 1905, Vol. XXII, p. 860.

**Hollis, Austin W., and Pardee, Irving H.: Recovery from Tuberculous Meningitis after Treatment with Intra-Spinal Injections of Anti-Meningococcus Serum; *Archives of Internal Medicine*, July 1920, Vol. XXVI, pp. 49-59.

they have added two of their own, making a total of 40 cases reported in the literature. The curative agents employed are fully reviewed. They advocate frequent spinal punctures and the intra spinous injection of meningococcus serum, believing the latter curative, "(1)—by adding to the spinal fluid certain anti-bodies which it is unable to develop itself, and (2)—by the introduction of a foreign protein." An examination of their cases would suggest that it is the action of the foreign proteid in lighting up a protective meningitis, (as advocated in this study), which is the chief curative agent, the cell count of the cerebro-spinal fluid increasing enormously after the injections.

Deductions:

The following conclusions may be drawn from an analysis of the thirty-one collected cases of recovery from a general suppurative—non-meningococus—meningitis.

I—The number of cures from general suppurative meningitis, either of local or blood-stream origin, is even smaller than generally is supposed. Consequently, general suppurative meningitis—with micro-organisms free in the cerebro-spinal fluid circulatory system—is an almost uniformly fatal disease.

II—The misconception that a fair proportion of recoveries of general suppurative meningitis of local origin have followed from operation, has originated from a failure to appreciate the diagnostic and pathological distinction between a lumbar puncture which reveals a cloudy fluid filled with leucocytes but without bacteria—a protective and reparative process—and the puncture which yields a turbid or a clear fluid containing micro-organisms—a general suppurative meningitis. Consequently a considerable number of the reported cures of suppurative meningitis were in reality cases of protective meningitis, and while clinically they presented severe meningeal symptoms, the general cerebro-spinal fluid system was not invaded by bacteria.

III—In the reported cases of cure from meningitis of blood-stream origin — five, of pneumococcus meningitis, Litchfield—the successful treatment undoubtedly was the intra-spinous injection of a serum which controlled the bacterial meningeal invasion, and probably stimulated the pro-

tective meningeal mechanism. The elimination of the blood-stream infection—either by the action of the blood itself, or with the assistance of a serum or vaccine acting upon the circulating blood—plays but a secondary part. In proof of this witness the immense number of cases of pneumococcic blood-stream infection, which recover spontaneously, contrasted with the almost uniformly fatal result when the meninges become bacterially involved. There is, however, microscopic evidence to warrant the belief that 25% of all general pneumococcic invasions are associated with a protective meningeal reaction.*

IV—Of the twenty-one reported cures from general suppurative meningitis of local origin, over two-thirds, or from fifteen to seventeen cases, had had *prior* to the general meningeal infection a meningeal protective reaction which was in action at the time of the general meningeal invasion. The invasion of the cerebro-spinal fluid circulatory system in these cases possibly was a temporary breaking loose of micro-organisms through the limiting and protective process.

V—Consequently, on account of this large proportion of cures in all the cases of local origin, it is reasonable to assume that it was largely through the presence and immediate action of this protective process that recovery resulted; assisted by the evacuation of the causative localized, intradural suppuration, (i. e., brain abscess, intra-piarachnoid abscess, or a suppurative labyrinthitis), and in rare cases possibly by the elimination of a causative extra-dural suppurative focus, which may be associated with a pachymeningitis interna—such as extra-dural abscess, sinus thrombosis or adjacent bony caries.

If this deduction be true it would suggest that it is of prime importance in the treatment of general suppurative meningitis that the surgeon direct his efforts to stimulating and assisting the protective meningeal mechanism. In the absence of a specific serum such as is now available for meningococcus meningitis this can best be accom-

*Herrick and Dannenberg: Observations on the Cerebro-Spinal Fluid of Acute Disease; *Journal American Medical Association*, November 1, 1919. Vol. 73. No. 18, p. 1321.

plished by keeping open the cerebro spinal pathways by subarachnoid irrigation.

VI—Of the small number of recovered cases of local origin in which no protective process apparently was in operation—five in all—the curative agents were so diversified that they may be regarded as more or less accidental.

VII—Lumbar puncture alone undoubtedly is of therapeutic value, probably because it is the means of removing some of the infected fluid, and possibly, by keeping open the cerebro-spinal pathways, it relieves, temporarily, the cerebral compression which favors intra-cerebral, and probably meningeal suppuration.

VIII—The number of cures in which an intrathecal injection of a serum has been employed—either alone, or in conjunction with other measures—is too large to be ignored. Consequently, it would suggest that the intra-spinous, intraventricular or cerebro-subarachnoid injection of a serum, even if it possesses no specific action on the particular type of infecting micro-organism, undoubtedly has a therapeutic value, probably by stimulating a protective meningeal reaction —the well-recognized tissue reaction to a foreign proteid.*

Conclusions.

From the foregoing analysis it would appear evident that, given bacteria free in the cerebro-spinal fluid circulatory system, in the presence of a localized focus of suppuration within or involving the dura, drainage of the intra-dural focus of infection, associated with lumbar puncture, offers a slight hope of recovery. In the absence of such an intradural suppuration, stimulation by a serum injected into the spinal or cerebral spaces of the cerebro-spinal system offers a slight prospect of recovery. But logically, in all cases subarachnoid lavage holds out a prospect not offered by any other therapeutic agent, as lavage alone keeps open the cerebrospinal system pathways.

Whether this hope will be fulfilled in the future, experience alone will decide.

*Cases cited by Du Bois, Eagleton, Watson-Williams and Day.

Report of Three Cases of Subarachnoid Irrigation with One Recovery.

Case VI. General Suppurative Intra and Extra Cellular Diplococcus Meningitis Following Compound Fracture of Skull, Treated by Intra-Cerebral, Subarachnoid Irrigation. Recovery. A. P. Woman

Résumé of Case: Compound fracture of base of skull from which patient apparently was recovering, but continued to complain of constant and severe headache. On the fifteenth day after the injury, severe meningeal symptoms. Lumbar puncture revealed diplococci, both intra and extra cellular. Intra-spinous injection of meningococcus serum. Subarachnoid irrigation promptly followed by recovery.

Patient admitted to Newark (N. J.) City Hospital, March 28, at 6:45 p. m.

Clinical Diagnosis: Compound fracture of skull.

Notes of Receiving Room on Admission: Struck by trolley car; patient unconscious and in shock; had a large, stellate laceration of scalp; bleeding from mouth, nose and left ear; right pupil enlarged, reacted slowly to light; also external strabismus of that eye; abrasion of left elbow; no other visible injuries; may have had fractured ribs on left side, but not definitely made out.

Physical Examination by House Surgeon: General appearance—well developed, well nourished, white female of 45, not conscious, pale, cold, clammy, aroused at times.

Head: Laceration of scalp, 5 inches long, running anterior from post-parietal region to temporal region, and another laceration running perpendicular to it at its middle and below it.

Eyes: Pupils equal, regular, reacted to light, sclera clear, conjunctiva not injected; external strabismus of both eyes; no nystagmus; eye grounds—discs pink, edges hazy.

Nose: Dried blood in both nares.

Ears: Right, negative; left, fresh blood in auditory canals.

Mouth: Blood in mouth; patient spat up dark brown blood. Jaws held rigidly so that examination of mouth was impossible.

Neck: No rigidity; no injury detected.

Chest: Breasts negative; heart, rate slow, of good quality, no murmurs; lungs negative; ribs negative.

Abdomen: Slightly pendulous, adipose, no masses.

Extremities: Negative.

Reflexes: Knee and ankle jerks not elicited; no clonus; no Babinski; no abdominals; no Oppenheim.

Nodes: Not palpable.

Skin: Negative.

Provisional Diagnosis: (1), Fracture of left base of skull involving middle fossa and parietal bone; (2), Laceration of scalp.

Antecedent Personal History: General health good; no injuries or shocks. Patient always had "stomach trouble." Father died from accident at the age of forty; mother died from rheumatism at sixty-five.

March 28: (Nurse's Notes): Patient admitted to ward; semi-conscious; color poor; pulse fair; camphor and ether mixture given in R. R. Lay quietly. Blood pressure taken. Vomited bloody fluid. At 1 a. m. delirious and very noisy.

Roentgen Diagnosis: Right negative; linear fracture left temporo-parietal region.

March 29: Eye grounds negative.

For a number of days patient vomited at times greater or less quantities of bloody fluid; rational at intervals only; noisy and talkative at intervals. Spinal tap; fluid obtained under pressure; 13 cc. of fluid removed. General condition remained unchanged, except for slight improvement in pulse (76). Blood pressure—100-130 Systole; 60-80 Diastole.

March 30: Dressing on head pulled off by patient. Clean dressing applied by nurse. Wound looked as if it might be infected. Patient restless and excited. Urine negative. Eye grounds negative. Blood in left ear. Temperature 99-100°.

April 1: Eye grounds negative. Patient spent a fairly good night. In the following days head ached at times, and patient complained of pain around heart.

April 5: Patient insisted upon taking bandage from head. Wound iodized and dry dressing applied.

April 6: Fairly comfortable by day; slept at short intervals at night. Temperature normal. Pulse 76. Blood pressure 120-80.

April 8: Somewhat brighter, but still had headache.

April 9: Patient still complained of headache; otherwise condition about the same as before. Following days severe headaches.

April 13: Right disc outline very slightly hazy; vessels full and disc slightly swollen. Lumbar puncture performed and 20 cc. clear fluid obtained without pressure. Patient more comfortable and headache less severe.

April 14: Patient restless, nervous and fretful.

April 15: Patient still restless, trying to get out of bed. At 4:30 a. m. got out of bed, fell and struck her head. In shocked, semi-conscious condition. Pulse of good quality. Patient very restless. At 7 a. m. unable to rouse patient. Patient had acted as if she had a slight convulsion on the floor when she fell. Blood pressure irregular—Systole 118-95; Diastole 70-55. Temperature normal. Pulse 72. Respiration 20. At 8:45 a. m. patient in a stuporous condition from which she could not be roused. Pupils equal, reacted to light; right disc indistinct. Knee jerks active. No Oppenheim. At 5:30 p. m. a lumbar puncture was performed; 20 cc. cloudy fluid obtained under slight

pressure. Pathological report on cerebro-spinal fluid; intra and extracellular diplococcus, "looks like meningo-coccic infection." Patient semi-conscious. Applied ice cap to head.

April 16: Voided involuntarily. Complained of headache. Temperature and pulse normal. Neck rigid. At 3:30 p. m. lumbar puncture performed; 32 cc. cloudy fluid obtained under slight pressure. Twenty cc. anti-meningococcic serum injected.

Operation at 7:35 p. m.: Craniotomy and irrigation of subarachnoid space.

Procedure: Exploration along line of fracture showed probable extension into base over temporal region. Closure and drain. Trephine opening in left frontal region in hairline three-fourths of an inch from medial line; cerebello-medullary cisterna entered by occipito-atlantal puncture; at a depth of about three and one-quarter cm. a cloudy fluid was obtained. Irrigation with physiologically balanced modified Ringer's solution at body temperature between openings through subarachnoid space of about 200 cc. Toward end of irrigation the recovered fluid became bloody and then ceased to flow. Dura in frontal region distended, and on removal of needle from frontal opening, fluid followed: evidently a block had developed, as fluid was being recovered a short time previously at the rate of about sixty drops per minute. The block may have been due to injury to a pial vessel.

Examination of fluid showed it to be cloudy, yellowish gray. Pus +. Chemical, globulin, large amount. *Cytogeny, polynuclears* +. Bacteria, meningococcus +.

Immediately after operation the patient was delirious and very noisy, but condition gradually improved.

At 11 p. m. patient out of ether; color and pulse good quality; pulse rate 120.

April 17: At 2 a. m. patient delirious and noisy. One-sixth of a grain of morphine and one one-hundred-and-fiftieth of a grain of atropine given, after which patient slept the remainder of the night. At 4 a. m. temperature was 101°; pulse, 88; respiration, 22. At 7 a. m. her general condition apparently was excellent. Patient conscious. At 8 a. m. lumbar puncture was performed; 30 cc. *slightly* cloudy fluid obtained under considerable pressure. Twenty cc. anti-meningococcic serum given. Patient had a comfortable afternoon that day. At 8:30 p. m. lumbar puncture gave 15 cc. slightly cloudy fluid under slight pressure. Twenty cc. anti-meningococcic serum given. Temperature 101°; pulse 90.

April 18: General condition favorable; patient had slept at intervals through the night. Examination of fluid showed the color, yellow; transparency, cloudy; nebula +; globulin, large amount; polynuclears +; bacteria, smears none. At 8 a. m. temperature 99.2°; pulse, 88. At 9 a. m. lumbar puncture gave 30 cc. almost clear fluid under pressure.

Twenty cc. anti-meningococcic serum given. Neck still rigid; knee jerks very sluggish. Kernig and Babinski in right side. At 10 a. m. lumbar puncture gave 25 cc. yellow, cloudy fluid under pressure. Fifteen cc. anti-meningococcic serum given.

April 19: Patient had slept all night and said she felt fine in the morning. At 9 a. m. lumbar puncture gave 32 cc. slightly cloudy fluid under slight pressure. Twenty cc. anti-meningococcic serum was given. Pathological report, fluid yellowish in color, cloudy; globulin, large amount; smears, no bacteria. Temperature, 100°; pulse, 90-96.

April 20: Patient slept all night, but voided involuntarily during the night. Temperature normal. Patient apparently entirely normal.

April 27: Discs clear. Patient insisted upon leaving hospital, regarding herself as well, not having had headache since the operation.

Case VII. Cerebral and Cerebro-Spinal Subarachnoid Irrigation for General Suppurative Meningitis (Streptococcic, Hemolytic) Originating from a Latent and Unsuspected Cerebral Abscess from a Gunshot Wound Traversing the Frontal Lobes of the Brain Eighteen Months Previously. T. P.; male.

Résumé of Case: About one and a half years previously the patient attempted suicide by shooting himself in the right temple with a revolver. He was brought to the hospital and operated upon by me. I removed a pistol bullet from the left parietal region, the ball having passed both frontal lobes, where there was a bursting fracture of the skull. The X-ray after the operation showed small fragments of bone or bullet near the wound of entrance, but the patient made a very good recovery and apparently has been quite well since. It is interesting to note, however, that after this time his history states that he has become a drug addict. There was a recent neurological examination before his second admission to the hospital.

On June 7, a few days before his death, the patient was found by the police in a more or less dazed condition and brought to the City Hospital, where he was placed in the observation ward for psychopathics, apparently little attention being paid to his former cerebral injury. It was noticed that he had a stiff neck, the patient walking around the ward in this condition. The interne in charge of the service performed a lumbar puncture which showed a cloudy fluid under pressure; when examined it showed numerous pus cells and many Gram positive cocci, many arranged in chains. A diagnosis of streptococcic suppurative meningitis was made, and the patient was transferred to my service.

Two attempts were made to wash out the subarachnoid cerebral space, and anti-meningococcic serum was given intraspinously, with the idea of the serum stimulating an aseptic protective meningitis. The patient grew worse after the second operation, but had appeared in much better condition after the first. Culture of the last fluid, shortly before death, showed definite hemolytic streptococci. Post mor

tem disclosed three latent abscesses, the oldest of which doubtless was present from the time of the original injury. One of them had perforated the lateral ventricle and slowly discharged its contents into it. From this the infection had passed to the basal cisterna and the cerebellar surface, the subarachnoid spaces of the cortex remaining unaffected.

History: June 7, admitted to City Hospital at 10:20 p. m. Temperature 100.2° and pulse 100.

Examination, June 8: Poorly developed and poorly nourished male adult, about 50 years of age, lying quietly in bed, acutely ill.

Head: Healed, irregular, depressed scar over right temporal region; bony depression just above the external occipital protuberance; healed, depressed, irregular scar over left superior temporal region; lividness, and some abrasion present over right eye.

Eyes: Rotary nystagmus present in right eye; less marked in left eye; moderate sub-conjunctival injection of right eye-ball; pupils round, regular, right $\frac{}{}$ left; react normally to light and air.

Nose: Abrasion on the bridge; tip turns toward the right; septum deviated to the left.

Ears: Present no sign of injury.

Mouth: Teeth in poor condition; tongue coated, fissured and furred; protrudes in the median line.

Neck: Marked refraction and rigidity.

Thorax: Normal contour; poor expansion.

Lungs: Resonant and clear throughout as far as can be ascertained with the poor co-operation of the patient.

Heart: Borders slightly enlarged to the left of nipple line; first sound at apex replaced by a soft, blowing, inconstant murmur; at base $\frac{A\,2}{P\,2}$

Arteries: Moderate degree of sclerosis and thickening.

Abdomen: Liver percusses one finger breadth below costal margin; no other masses or points of tenderness made out. Tache cérébrale is positive.

Genitals: Incontinence of urine.

Reflexes: Deep reflexes present; hypo-active, but equal; double Babinski and double Kernig present; no ankle clonus obtainable.

Diagnosis: Streptococcus meningitis.

Psychiatric Examination, Wednesday, June 8: "I've been here three or four weeks." (Was admitted yesterday). Does not know day, month or year. Says "*1821.*" At 10 a. m. says it is about 3 o'clock. "I don't know why I am here. I don't know who brought me here, either. I wasn't drunk. I don't know what was the matter with me."

Why do you stay here? "I don't know that either." Using drugs? "No." Anything hurt you? "No." Were you here before? "I imagine so." Have any trouble? "We had quite an argument—my

brother—a little family affair.'' Did the police bring you in? ''I don't know.'' Did you try to kill yourself? ''No.''

''Harding is President; Wilson before him; Hauseling is Mayor.''

''4×4=16+10=26−8= —well—'' (then no answer).

''9×9=81+9=81—oh, well—'' (Then no answer.)

''6×6=36+8= —well—'' (Then no answer).

''20−1=19.'' (Correct, but slow).

''Before July comes August; before December, November; before October, September—'' (after some thought).

Name the months of the year. ''This month—'' (Then no answer).

Memory for numbers poor—''3, 4, 8, 7.''

No dysarthria.

Both pupils very sluggish to light—both irregular. Suspicion of Romberg. Knee jerks exaggerated. Urine dribbled during examination. Executes commands sluggishly. Gait somewhat spastic. Marked tremor of fingers.

June 9: Temperature 99.2°, pulse, 110. Incontinent; neck stiff.

Lumbar Puncture: Fluid cloudy under slight pressure; Wassermann negative; direct smears show streptococci. At 8 p. m. pulse 130-90.

Operation at 11:30 p. m.: Cerebral and spinal subarachnoid irrigation. Three trephined openings made in right fronto-parietal region; in the first it was found impossible to enter fluid because of apparent adhesion of dura to brain, although the opening was away from the skull opening through which the ball had been extracted, by at least one and one-half inches. Two other openings were then made: opened into the subarachnoid space, and tap made into cisterna magna. Needle inserted underneath dura and arachnoid and surface of brain flushed out with Ringer's solution and drained through needle in cisterna. Fluid at first yellow, turbid, then bloody, then yellow again. Process repeated twice through trephine one inch posterior to first opening on the same side. Later the excess fluids were drained through a lumbar puncture. Flaps closed with black silk.

12:45 midnight: Pulse 130—good quality; color fair.

2:40: Out of ether.

June 10, 8 a. m.: Pulse 9; ''good and regular.'' Temperature 101°. Patient lies quietly, seemingly staring into space. Blood pressure 120-90.

12 Noon: Temperature 102°; pulse 120. Lumbar puncture; fluid cloudy, slightly blood-tinged; anti-meningococcic serum injected intraspinously.

6:30 p. m. Nurse's Note: ''Seems to understand when spoken to. Does not talk himself. Patient incontinent.'' Laboratory report: ''Fluid contains pus and blood; Gram positive cocci.''

4 p. m. Temperature 100°; blood pressure 140-95.

June 11, 8 a. m.: Temperature 99°; pulse 96. Nurse's Note: ''Patient

appears to be much better this morning. Answers intelligently to questions. Neck still very rigid and head thrown back."

12 Noon: Lumbar puncture done; 28 cc. withdrawn, fluid cloudy, slightly yellow, under slight pressure. Anti-meningococcic serum 20 cc. injected. At this time I examined the patient and instantly saw that the man was in excellent condition. He recognized me at once and recalled all about the previous experiences in the hospital eighteen months ago.

3 p. m.: Lumbar puncture; fluid cloudy, under moderate pressure; 30 cc. serum injected.

4:45 p. m.: Blood pressure 140-95.

6 p. m.: Second subarachnoid irrigation. Anterior flap opened; stitches removed; needle inserted under arachnoid and irrigation carried on as on the previous day. Drained through cisterna and lumbar puncture. Fluid yellow and somewhat turbid. Flap closed with black silk.

7:15 p. m.: Patient returned to ward. Pulse 130, of good quality.

10 p. m.: Pulse 120.

11:30 p. m.: Blood pressure 170-130.

June 12, 4 a. m.: Blood pressure 155.125. Pulse 120.

8 a. m.: Patient's condition did not seem so good. Pulse fair. Answered when spoken to.

8:30 a. m.: Patient suddenly became cyanosed and pulseless and ceased to breathe.

AUTOPSY AND REPORT BY DR. HARRISON S. MARTLAND.

External Examination:

Showed a male body, about fifty years of age. "There is slight recent loss of weight. Moderate rigor in smaller and larger joints and moderate lividity over dependent portions of body. The skin over the entire body is free and clear.

Examination of the head shows a recently shaved head, with a recent sutured operative incision over the right temporo-parietal region, the surrounding skin being covered with silver foil.

Over the right temporal region is an old, small depression and opening in bone, over which the skin is firmly adherent and contains a small, old scar wound of entrance of bullet.

Over the left parietal region is an old linear scar under which the bone is replaced by membranous tissue for a distance of about 3 cm.—the wound of exit, or surgical extraction of bullet."

Internal Examination:

Head: Examination of the skull and brain showed the following: "The old wound of entrance of bullet situated in the right temporal region shows an old scalp scar, adherent overlying skin, and a small opening in the bone with rounded edges; the dura beneath is firmly

adherent and there are numerous adhesions between the dura and pia-arachnoid about this small area. In the cortex of the middle of the F. I. lobe of the right frontal lobe is a small, cortical and sub-cortical abscess, measuring about 1.5 cm. in size and filled with thick, creamy pus containing a few small fragments of bone; the wall of the cavity is about 2 mm. in thickness.

Situated deeper in the brain substance, its outer edge encroaching on the small abscess already described, is another more recent and larger abscess, measuring about 2.5 cm. in diameter, and containing a slightly greenish pus; its walls are about 1 mm. in thickness. The lower and inner portion of this abscess cavity communicates with a smaller and still more recent abscess cavity, about 1.5 cm. in size, which leads directly into the anterior horn of the right lateral ventricle, at the opening being soft and necrotic brain tissue.

The right ventricle is distended with greenish-yellowish pus, and there is an extensive exudate clinging to the choroid plexus; the ependyma lining the cavity contains numerous punctate hemorrhages, and the surrounding brain tissue is soft, oedematous, and in places distinctly necrotic. This same condition is found in the left lateral ventricle, although not to so marked an extent.

The third ventricle contains purulent exudate and fluid pus, and the interpeduncular cisterna is distended with purulent exudate. The fourth ventricle is dilated, as is also the iter, and contains a purulent exudate and free pus. This has leaked out through the foramina of Magendie and Luschka and infected the cisterna magna, which is filled with a plastic, purulent, yellowish exudate, which extends up over the inferior and lateral surfaces of the cerebellum and stops. The cisterna basilis and chiasmatis contain considerable plastic exudate, which apparently comes from extension from the cisterna magna, and possibly also from the close proximity of the infected third ventricle. The outer surfaces of the brain and the spinal cord and its meninges are practically free from exudate.

Over the right cerebral hemisphere in the calvarium there have been three recent trephine openings, all about 2 cm. in size, and filled with recent blood clot. The dura under each has been sutured and the anterior opening over the right frontal lobes shows a small, hemorrhagic extravasation in the leptomeninges—a needle puncture for washing out the subarachnoid space. The other two show a similar but not so marked a condition.

Extending from the wound of entrance in the middle of the F. I., passing across the frontal lobe on its superior surface, to the left and slightly backward, through the left frontal lobe on its superior surface, and stopping at the bone opening in the left parietal region, is a somewhat collapsed brain tract of the old bullet wound. The brain tissue is stained a gamboge yellow around this old tract and

there are numerous piarachnoid adhesions over this area. The anterior trephine opening for washing the subarachnoid space is included in this area, and the surrounding adhesions probably prevented the free admittance of fluid.

The base of the skull and accessory sinuses are free and clear. In the posterior part of the foramen magnum there are two small puncture wounds through the dura and arachnoid in the space between the skull and axis. There is a small amount of recent blood about these openings. The anterior surface of the pons and medulla shows considerable recent hemorrhagic extravasation in the cisterna pontis, but there seems to be no anatomical connection with the needle punctures, and it probably is due to toxic action of streptococcus in the exudate in this region.

The spinal cord is practically free and clear.

Peritoneal Cavity: Viscera in normal position; free and clear.

Pleural Cavities: Free and clear.

Heart: Heart muscle soft, friable, and pale red in color, with indistinct bundles; otherwise free and clear.

Lungs: Show terminal oedema and small areas of terminal broncho-pneumonia.

Examination of other viscera is negative except for cloudy swelling of heart muscle, liver and kidneys.

Probable Cause of Death: Gunshot wound in head, penetrating, wound of entrance in right temporal region, crossing both frontal lobes, supra-ventricular, and stopping in a bursting fracture of the left parietal bone. Wound made over one and one-half years ago in attempted suicide.

Secondary, or Terminal Lesions:

1. Encapsulated abscess of right frontal lobe, cortical, recent progression of infection from encapsulated abscess to brain substance around abscess, with formation of two more recent abscesses, one finally rupturing into the anterior horn of the right lateral ventrical.

2. Spreading, generalized suppurative ependymitis, extending rapidly throughout the entire ventricular system.

3. Terminal suppurative meningitis, fairly well limited to the cisterna magna, cisterna pontalis and cisterna basalis.

4. Three recent operative trephine openings with small puncture wounds of the underlying piarachnoid and sub-occipital needle taps for washing the sub-arachnoid space.

5. Cloudy swelling heart muscle, liver and kidneys and terminal broncho-pneumonia.

Historical Landmarks: Old bullet tract through both frontal lobes.

Autopsy Findings: Old gunshot wound of superior frontal lobe, with dura adherent over area of exit of bullet, and underneath an abscess (small) with organized wall communicating with larger abscess, result-

ing in basal meningitis and extending from cisterna—filled with pus—up to lateral ventricles and producing an ependymitis and encephalitis."

Comments: Of course, a brain abscess should have been suspected, and an attempt made to drain it, possibly associated with subarachnoid irrigation. Subarachnoid irrigation, however, would of course have been useless without the removal of the cause.

In view of the excellent condition of the patient just prior to the second irrigation—with the rapid rise of blood pressure and the sudden termination, one is forced to the conclusion that death resulted from cerebral compression, probably induced by the irrigation. In addition to the over looked abscess, the patient probably was over-treated both as to lumbar puncture and serum injections, and subarachnoid irrigation.

Case VIII. Case of Delayed Pneumococcus Meningitis from Otitis. Incomplete Subarachnoid, Spinal and Cerebral Irrigation on Tenth Day of Disease. M. M. B.: Child, 8 years of age. Seen with Dr. Barkhorn.

History: Two weeks previously patient had an earache; paracentesis was made by Dr. Barkhorn, followed four days later by a mastoid operation. Large antrum found. For the next week nothing unusual noted, except that on second day child vomited several times. It then appeared perfectly well, and was discharged from hospital.

One week after vomiting attack child awakened in the middle of the night with sudden and severe pain in the head and again vomited. The vomiting continued about every hour for eighteen hours, and then stopped. During the next three days it had continuously high temperature, running from 102° to 105°.

When seen in consultation patient had stiff neck, coma, cell count of cerebro spinal fluid over 900, fluid under pressure, globulin increased, Fehling's reduced, no micro-organisms.

Operation, April 8: (Two weeks after initial earache and ten days after first vomiting attack.)

Trephine hole drilled in right frontal region. Mastoid of right side then widely opened, both above and behind; nothing revealed. Dura punctured over the tegmen; small amount of cerebro-spinal fluid; no hemorrhage. A lumbar puncture was then performed and subarachnoid drainage established. Drew away about 100 cc. of turbid fluid, allowing about 55 cc. of fluid to run into subarachnoid space of frontal region. The tension in the lumbar puncture needle rapidly fell. So far as we could make out the irrigation was not very successful. Could not tell whether the out-flow was increased by the fluid which entered from above or not, although the out-flow contained cloudy fluid with considerable exudate. Gradually the out-flow fluid stopped running.

The injected fluid was introduced very slowly, at about the rate at

which cerebro-spinal fluid normally drops from a lumbar puncture needle. The temperature of the in-flowing fluid was kept continuously at the body temperature. At the completion of the operation the child's pulse began to rise a little; otherwise there was no apparent effect constitutionally. Three hours after irrigation temperature was 101°, and pulse 108.

Laboratory Report of Fluid: "Cloudy, globulin increased, Fehling's slightly reduced. Smears show numerous streptococcus mucosus—sometimes known as pulmococcus mucosus, or pneumococcus Type III."

Blood culture negative.

Cadaver Experimentation: Following this failure I demonstrated on a cadaver that with an in-take needle in the frontal region and the out-flow needle in the lumbar region, on injecting the upper needle only about thirty drops per minute could be recovered from the spinal region. However, with the out-flow needle in the occipito-atlantal region, fluid could be irrigated from the frontal region, the fluid being recovered freely in a continuous stream from the occipito-atlantal needle. Also, that using the occipito-atlantal needle for the in-take, fluid could freely be recovered from the lumbar region.

April 9: Since operation the child's condition apparently has greatly improved. The temperature has continued high, however,—around 103°—but the pulse since last night has become slow—88.

April 10: The child presents the usual picture of meningitis—at times restless and again quiet; temperature 102-104°, but pulse slow—68-92.

Lumbar puncture; Laboratory report: Fluid cloudy, globulin increased, Fehling's reduced very little. Smear, streptococcus mucosus, number only slightly increased over previous specimen.

April 11: Several involuntary bowel and bladder movements. Sleeps at short intervals. Delirous at times. Temperature 104°; pulse fast—135.

April 12: Patient weaker than yesterday. Takes little nourishment, but swallows well. Delirious and restless. Temperature 103-104.4°; pulse 126-130.

Second Irrigation, from lateral cisterna to lumbar region. With the experimental data I had obtained, I made a puncture through the lower portion of the mastoid wound, over the posterior fossa, a small opening being made in the dura, and the in-flow needle placed in the lateral basal cisterna, and an attempt made to irrigate from this through to the lumbar region. The fluid obtained by the lumbar puncture was at first almost pure pus. This operation also was not very successful because of the large amount of exudate, which continually clogged the needle in the lumbar region and necessitated the frequent passage of a stilette to free its lumen. The amount of fluid washed through was not more than 55 cc. At the end of this procedure the child appeared to suffer slightly from shock; the pulse began to rise and there was a

tendency to some excessive moisture of the skin, doubtless because of the prolonged manipulation. There was no respiratory involvement whatever. This operation, also, I regard as more or less of a failure, although a large amount of exudate undoubtedly was washed away.

Laboratory report of fluid: "Fluid recovered very cloudy; pus organisms increased double that of April 10; Fehling's not reduced; globulin greatly increased."

Following the irrigation the child apparently was much improved. Temperature 103 104 °; pulse 130.

April 13: Nurse's notes during night following second irrigation: "2 a. m. Patient seems to rest quietly the last few hours. 4 a. m. Patient resting quietly; seems to be improving. Temperature still high; pulse slower."

Twenty-four hours after the second irrigation, at the request of the child's family, who had noted a marked improvement after each of the previous irrigations, another irrigation was done.

Third Irrigation, 5 p. m. Occipito-atlantal puncture, reaching the basal cisterna at 4¼ cm., the landmarks given by Ayer being followed. The dura was distinctly felt, and on perforating it a large amount of very cloudy fluid was recovered. The in-flow needle was then introduced through the old trephine opening in the frontal region and I was enabled to wash through a large amount of fluid, although the needle in the medullo-cerebellar cisterna was constantly being clogged by the exudate. At first the flow was free from the out flow needle, but gradually it became much thicker. At this irrigation at least 200 cc. was washed through.

Laboratory report on fluid: "Pus and organisms greatly increased. Streptococcus mucosus."

Following this third irrigation the pulse was fast—168; respiration also much faster 40; temperature 102 104 °.

April 14. Notes: "Left internal strabismus. Convulsive movements inward of left eye, the right remaining fixed, looking sharp ahead. Both O. E.: veins full, not tortuous. Arteries also full. Right disc may have slight indistinctness of upper margin." The pulse has been faster since the last irrigation. Exudis twenty-four hours after last irrigation.

AUTOPSY AND REPORT, BY DR. FREDERICK SUTTON.

Simple extensive mastoid wound right side. Moderate hemorrhage under scalp. Half inch frontal trephine opening. Extra-dural blood clot small. On opening dura, moderate sub-dural hemorrhage—right side—extending back to tentorium. Two clean needle punctures in dura. Needle punctures in dura atlanto-occipital joint slightly to right of center. Slight extra-dural exudate about mastoid wound. Needle opening just above external semi-circular canal. Petechial hemorrhage in dura over right frontal area. Similar condition sub-dural.

Brain: Superior surface microscopically clear of pus. Considerable

oedema and congestion. Ruptured blood vessel beneath needle puncture, small amount of hemorrhage. Slight area of necrosis corresponding to needle opening in mastoid wound. Moderate pus in both Sylvian fissures, bathing pons and cerebellum down to cord; *more marked on left side than on right.* Right tri-facial nerve oedematous, and containing pus infiltration (5th). Apex of petrous bone not involved. Right lateral sinus patent; no clot. Right superior pretrosal clear. Left side lateral sinus branches one and one-quarter inch from torcular, lower entering one-half inch below the upper. Both branches patent. Left superior pretrosal patent. All sinuses clear. No diseased bone found in mastoid. Optic nerves clear. Sella and pituitary clear. Pus in left post-ethmoids. Smear showed streptococcus mucosus. Right ethmoid clear. Muco-pus in right sphenoid—smear showed streptococcus mucosus. Left sphenoid free and clear. Both frontal sinuses dry. Right semi-circular canal clear. Left middle ear clear. Right middle ear smear—numerous streptococcus mucosus.

Comments: The meningeal involvement probably occurred in the second day after the mastoid operation, but was localized and controlled by the protective meningeal mechanism until one week later, when it became general.

From my experience of this case it would seem that it is a dangerous thing to keep on irrigating after the flow stops, because undoubtedly at the completion of this operation it caused compression symptoms. The child was more or less comatose at the time of the irrigation. The important thing to remember is that it is feasible to wash directly across the brain, over the basal cisterna, into the occipito-atlantal space; but we must not wait until the exudate is firm, because the exudate fills the needle. Also, we must use a graduated needle; and the needle must not be too long, as was the case with ours, because the longer the needle the more apt it is to become filled with the exudate.

The post-mortem undoubtedly showed that the side irrigated was very much less infected than the opposite side. It also showed how easy it is to slip the needle under the dura into the arachnoid space and cause a hemorrhage, unless it is held very firmly. The needle that goes into the subarachnoid space should be guarded. It is not necessary to guard it in the occipito-atlantal space.

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N. B. Since the above article was written one other cured case has been reported by Rosenau.*

Discussion.

Dr. Edward B. Dench of New York said that the Society owed Dr. Eagleton a debt of thanks for presenting this subject in a very masterly manner. The work accomplished had

*Rosenau, G.: Heilung der Pneumokokken Meningitis durch Optochin; *Deutsche Medizinische Wochenschrift*, 1920, No. 1., p. 9.

been enormous, and he had given the subject a great deal of study, adding a great deal of his own work to elucidate that of others. There were one or two points deserving of special mention: Dr. Eagleton had mentioned that it was the quantity of organisms, more than the special variety that counted, but it might be said that virulent organisms grow quickly and would cause more infection than an equal quantity of less active organisms. He was impressed by the numerous cases of concomitant meningitis that occurred as a result of infection of the blood stream perhaps through the nasal mucosa that took place at the time the ear became infected. He thought damage had been done in cases in which there was systemic infection. Dr. Eagleton's case had earache 72 hours before death. Often meningitis was evidence of general infection and ear symptoms were produced by localization of this infection, and the brain symptoms occurred at the same time. He did not in these cases consider meningeal infection as secondary to that of the ear. They were accustomed to report cases of otitic meningitis which were not so at all; they were meningitis with otitic complications. One case he recalled of a child who had earache; operation was done and the temperature fell to normal and remained so two weeks. Then there was pain in the abdomen and a pneumococcus peritonitis set in with fatal ending. The pneumococcus infection was a generalized blood stream infection. It was necessary to draw a distinction between meningitis associated with otitis, and that secondary to otitis. The distinction of the types of meningitis showed the masterly work of Dr. Eagleton on this subject. It was known that patients might go along without symptoms and then suddenly die of meningitis. That was a not uncommon experience. In classifying a protective type of meningitis, Dr. Dench did not agree with Dr. Eagleton. There might be such cases, with walling off of the subarachnoid space, thus protecting the system from further infection, but it was difficult to say where protective processes stopped and where general invasion began. Was it possible to make a diagnosis and say "let this case alone" or to see another and decide it was not

protective and try and do something for it. In regard to operating on cases requiring opening of the dura, the body, or higher, temperature must be maintained to avoid shock. The brain must be douched with warm solution and the temperature kept up. The theory of washing out the subarachnoid was excellent, and if one could remove the poison from the cerebro-spinal fluid system, one would prevent extension of systemic infection. These cases died from infection rather than compression, though the latter had been given the credit, and Dr. Dench said he had been one of the chief offenders in maintaining this belief. Probably, however, by relieving compression by widely exposing the dura the cerebrospinal system had more space in which to functionate and to favorably influence recovery. In regard to Dr. Eagleton's remarks about removing primary foci; he did not believe it did much good to remove mastoid infection in cases presenting meningeal symptoms 24 hours after the earache, to prevent meningitis. Infection was not likely from the middle ear unless there were abnormal conditions there. Infection was not likely to travel through dense bone in 72 hours, as in Dr. Eagleton's case.

Dr. Dench asked if the canula was passed into the ventricle or simply into the arachnoid space. It would be difficult to get it into the arachnoid space alone. Dr. Dench asked the composition of the Ringer's solution used.

Dr. B. Alexander Randall, Philadelphia, said that articles on intracranial complications had laid stress on thrombosis rather than upon meningitis, probably because meningitis cases had been uniformly fatal and relief measures inadequate. There was little to do except notify the undertaker. Meningitis in all forms was not always easy to distinguish from meningismus, which gave serious manifestations. Some cases no doubt were spontaneous cures, and the doctor thought cure was due to his measures. Arachnoid irrigation had been urged for years by the speaker and he had a spatula-like instrument for the purpose. Irrigation could be

made from the longitudinal fissure above to the foramen magnum below. In a case of fracture with infection, Dr. Randall said he did exploratory operation, looking for abscess in the temporosphenoidal region, and irrigated over the temporal area. Lumbar puncture gave cloudy fluid with streptococci. For every quart of saline injected, he obtained a pint from the arachnoid space. The possibilities of irrigation by the blood stream were greater than realized; entero-cylsis by drinking was a useful, feasible measure. Calcium with its action on the vessels helped in its action on the brain, but in bringing these cases through, one sometimes regretted keeping alive a paralysed patient, who remained a burden to himself and friends. Another useful method was by aeration, easy in the peritoneal cavity, but difficult in the cerebral. The subarachnoid space must be left to nature, but they could treat the arachnoid.

Dr. Francis P. Emerson, Boston, said he had seen one case at Camp Lee, with follicular tonsilitis, which developed mastoid infection with meningeal symptoms. A mastoid operation was done and the lateral sinus exposed, which showed evidence of changes of the sinus wall. Next day the jugular was ligated. The man had all the evidence of meningitis, with cloudy fluid, containing S. hemolyticus, papillitis, positive Kernig, mental dullness, and apparently was going on to a fatal ending. However, he recovered. Probably that case had the protective meningitis Dr. Eagleton spoke of, and removal of active blood stream infection enabled him to overcome the meningitis. Dr. Eagleton's viewpoint was interesting and gave them a new means of attack against these serious cases of infection.

Dr. Ewing W. Day, Pittsburgh, said that this had been the most valuable paper he had ever listened to. There was a definite relation between the cerebral circulatory system, and the arterial and venous system; one worked within the other. A few points should be emphasized: one was that the infection may travel against the current.

Many cases no doubt got well, where infection was implanted on the brain tissue at the place where the arachnoids thinned out and became capillary. The cerebral stream localized the infection and eliminated symptoms. Often after mastoids the patient had slight temperature and felt sick; this was often a sign of localization of infection. If one reversed the stream, and drew the infection downwards, one ran the danger of carrying the infection down to the base. In this lay the danger of indiscriminate lumbar puncture, releasing the infection from above where it might be comparatively harmless, and bringing it down where basilar meningitis may develop. What were called symptoms of beginning meningitis were not really so, but were the third or terminal stage. Positive Kernig, intolerance to light, etc., meant advanced meningitis. To overcome meningitis one must be able to do adequate drainage. Haynes' operation only drained the ventricles and but slightly touched the arachnoid space. Dr. Day hardly agreed with Dr. Eagleton as to types. He had seen a most severe meningitis caused by staphylococcus. At Litchfield, at Camp Grant, there were ten cases of pneumococcic meningitis, with five recoveries by the use of Keyes' chicken serum (J. A. M. A. May 10, 1919). This is however, difficult to obtain when needed. Infection, not pressure, in these cases is the important factor. He would like to hear Dr. Eagleton's technic. He had tried the operation, but did not believe he had done more than inject the arachnoids, not irrigate them.

Dr. S. MacCuen Smith, Philadelphia, said he wished to express his great appreciation of Dr. Eagleton's work. He, himself, had read a paper before the New York Academy of Medicine, in which he stated that rigidity of the neck and intolerance to light were late manifestations. What could be done before these appeared? Probably the best diagnostic method was lumbar puncture, but if we are to accept the theory that under certain circumstances withdrawal of fluid causes a vacuum which will draw the in-

flammation from the upper part of the brain to the base, thereby inducing a basilar meningitis in addition, we must be careful to avoid this unfortunate occurrence.

Dr. Ewing W. Day, Pittsburgh, mentioned one point that was often omitted in making a diagnosis, and that was the use of the manometer. With the use of this instrument, one could detect alterations in the cerebral pressure and if one found a pressure above 150, one knew there was something wrong.

Dr. B. Alexander Randall, Philadelphia, added that opisthotonus was important. It was frequent that medical men followed ignorantly a valuable measure, without knowing why they did it. In raising the head and pushing it forward, even with pin point pupils, there occurred a dilatation of the pupil. This was caused by increased pressure, and showed the extreme sensitiveness of the structures to pressure within.

Dr. Edward B. Dench said that he did not feel they should leave the subject with the impression that lumbar puncture should be discarded. When infection had spread to the base, it was often a valuable therapeutic measure.

Dr. Ewing W. Day, said that he did not mean that lumbar puncture should be discarded. After infection had become basilar one could puncture as much as one pleased, but the point was not to bring down an early infection to the base. In early suspected cases pressure should always be taken, and the minimal amount of fluid removed for laboratory examination. One half c.c. is sufficient. This will lessen the chance of spreading a localized infection.

Dr. Arthur B. Duel, New York, said Dr. Day had offered one very important diagnostic point, which he, personally, had never used; viz: the manometer. Inasmuch as it was possible with the manometer to determine change in pressure by simply extracting as small an amount as one c. c.

of fluid it avoided the danger of reversing the current by removal of too much fluid.

Dr. Wells P. Eagleton, in closing, said that Dr. Dench spoke of peritonitis and general infection, but asked why all these cases began with earache if they were primarily blood-stream infections. In his opinion they were primarily ear cases, and the infection entered the meninges, where it remained latent until something overcame the protective mechanism and caused meningitis, and then a general infection which might manifest itself anywhere in the body.

During the latent stage one could do something by stimulating the protective mechanism of the brain. In his opinion the type of serum had comparatively little to do with the reaction. It was simply a foreign protein stimulus. As to Dr. Dench's inquiry about technic:—a specially formed canula was used; the dura exposed; the meshes of the sub-arachnoid entered and irrigated. Experiments showed that there was free communication of the side irrigated and two-thirds of the other side, as well as through the basal cisterna and down the spinal column. This technic should be studied in the cadaver. Ayer's puncture was very simple. Probably a good method would be to wash from below up, but so far he had not had the courage to do so. In regard to the solution, the modified Ringer's solution contains the necessary calcium salts. There was no change in the cell contents after passing through the sub-arachnoid spaces.

POST-OPERATIVE TREATMENT OF THE RADICAL MASTOID OPERATION.

By J. A. STUCKY, M. D., Lexington, Kentucky.

The topic as given to me by the Program Committee, to be considered in this symposium would indicate that at least two other phases of this major surgical operation had been or were to be considered; 1, the Indications for the Radical Mastoid Operation; 2, the Technique of the Radical Mastoid Operation.

The post operative treatment of the radical mastoid operation, is of special interest to the surgeon because the uncertainty of its duration, the annoying complications and results of neglect to patiently and perseveringly, almost daily for many days or weeks, to treat the case, make it the operation to be most dreaded and avoided by the patient and otologist.

This is due to the fact that so many operators have had unsatisfactory results even after long and careful after treatment. As a basis for the after treatment of the radical mastoid operation, it is assumed, (1) The operation was indicated, (2) A complete operation was done, (3) The tympanic orifice of the Eustachian tube was closed, or so nearly so as to prevent retention of secretion and moisture in the middle ear cavity.

The two things that make any post operative treatment uncertain as to time and results are (1) An incomplete operation, (2) neglect to so modify the bony and cartilaginous meatus as to produce the best facilities for drainage, ventilation and inspection, and failure to thoroughly remove the pathological conditions in the different recesses of the middle ear cavity. The post tympanic space and Eustachian tube are often a source of a purulent discharge and necessitate a protracted treatment.

Since my paper before the Society, 1915, I have performed

the complete radical operation on the mastoid in only a few cases, the modified operation as advocated then giving satisfactory results, except in cases where there was indication of extensive necrosis in the attic and mastoid process or intra-cranial involvement.

Post operative treatment begins as soon as the operation is completed, the external wound sutured, cavity dried and inspected.

The healing of the external wound is much quicker and more satisfactory if traumatism of the surrounding area is minimized. The unnecessary use of a number of hemostats and the too forcible and long continued use of retractors may so lower the vitality of the parts, as a result of bruising and stretching, that union or healing is seriously impaired.

I have used the various antiseptic solutions in the operated area, during and after completing the operation, but none has given me as uniformly satisfactory results as a 1 to 1000 solution of alphozone. This powder is readily soluble in water, is thoroughly antiseptic, non-toxic, and does not interfere with the blood clot when this is used in the classical mastoid operation. This remedy is made of Succinic Acid and hydrogen peroxide and is said to be "as germicidal as mercury bichloride, 75 times as germicidally powerful as carbolic acid, 100 times stronger than formaldehyde, etc.," but the solution must be freshly prepared as "when dissolved in or in contact with water, alphozone combines with a portion of the water and undergoes a change known as hydrolysis."

Satisfaction or success in the post operative treatment consists in rapidly obtaining and maintaining a dry cavity, covered by a vascular fibrous dermatized membrane.

The completeness of the operation and refinement of technique has much to do with attaining this end, but notwithstanding the thoroughness of the operation and perfect surgical technique used, neglected after treatment will result in disappointment or failure of the operation.

In some cases it is most difficult to keep down granulations,

and granulations decrease hearing, especially if allowed to form on the internal wall.

The first dressing at time of operation after the saturated alphozone gauze strips are carefully removed, folded strip of gauze, which had been saturated with 5% iodoform emulsion and so applied through a large speculum as to touch every part of the cavity, and tight enough to prevent any sagging of the fibro-cartilaginous wall or contraction of the external auditory meatus, at the same time care must be used to pack evenly but not forcibly, the latter may result in interference with free circulation in the soft parts or displace the flaps made from the fibro-cartilaginous canal.

The external dressing consisting of pads of folded gauze wet in the 1 to 1000 Alphozone Solution, snugly fitted around the external cartilaginous ear, over this absorbent cotton is applied and held in place by a bandage. This external dressing is allowed to remain for at least 48 hours when it is removed and a similar, but lighter dressing is applied. The packing in the cavity is not removed for four or six days after the operation and this should be so carefully done as not to cause pain, or bleeding or interference with the firm union of the fibro-cartilaginous flaps.

The cavity is not irrigated but thoroughly dried with absorbent cotton, and again packed with 5% iodoform gauze. In the second dressing I do not use the iodoform emulsion. At this time the sutures are removed, and folded gauze placed over the posterior wound, held in place by the bandage. Best results have been obtained by rapidly reducing the amount of external dressing and doing away with the bandage—both are uncomfortable and retain too much heat and moisture. The wire screen mastoid protector (Fig. 1) devised by me some years ago, I find most satisfactory and enables me to do away with the heavy dressing and bandage on the fourth or sixth day after the operation. After the second packing is removed from the cavity which is usually on the fourth or fifth day; no further packing is used unless there is sagging or prolapsis of the metal flap but instead the entire cavity is filled with powdered boracic acid, two or

three times a day, until the cavity is thoroughly dry and covered by a vascular fibrous membrane. For two or three days after beginning the use of the boracic acid there is quite a free discharge of sero-purulent or serous fluid which fills the bowl of the external ear. This is removed with sterile cotton, the middle ear cavity dried with same material by means of applicator. The object being to keep the cavity as free as possible from heat and moisture, covered with the powdered boracic acid, thoroughly ventilated and protected from infection.

Slow recovery, elevation of temperature or post-operative fever, I have found to be more frequently due to absorption of proteids or toxins from the intestinal canal and not from

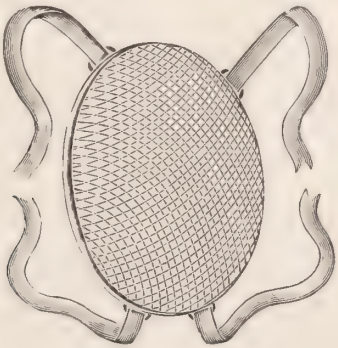

Fig. 1. Wire Screen Mastoid Protector.

sinus thrombosis. Most cases requiring the radical mastoid operation are more or less septic—the vitality and power of resistance is far from normal and to this condition we are to add the results of the anesthetic plus the operation.

It must be remembered that in septic conditions food not digested and assimilated thoroughly deranges the body chemistry, fermentation and putrification go on.

Ordinary bowel movement may remove some of this, but an empty alimentary canal does not mean a clean one; peristalsis is imperfect and the result of food putrification, and small particles of fecal matter remain in the folds and pockets of the canal, which give rise to toxins which easily

find their way into the blood and lymph stream. For these reasons, immediately after the operation the patient is kept comfortable for at least 24 hours; usually the administration of one hypodermic of 1 12 or 1/8 gr. of heroin will accomplish this. Free purgation, restricted diet (protein free), daily bath and gentle massage, fresh air, sunshine and rest.

The method I have outlined is the treatment I have followed almost exclusively for the past eight years, because of the satisfaction given. The cavity is dry and dermatized usually in from three to six weeks.

Other methods, such as skin grafting, blood clot, bismuth paste and parafine, etc. in my hands have not been satisfactory.

Discussion.

Dr. Edward B. Dench, New York, said that Dr. Stucky omitted mention of obliteration of the hypotympanic space, which was important. He said that he always used the graft, a primary one, except in very foul cases, when a secondary graft was used. If Dr. Stucky would use this method he would find it excellent. The graft would not fill all irregular spaces, but would become folded in some places, and the underlying tissues would not be completely covered, but the Eustachian tube would be closed and the tympanic cavity dry at the end of two weeks, and the rest of the cavity would take care of itself. If the skin grafting method was not used, granulations, the bugbear of otologists would take place. These should be curetted and cauterized with a silver nitrate bead. In regard to the flap Dr. Dench said this is stitched with 10 D on cat gut, taking the cartilage out of the flap. If the flap is too thick, owing to neglected infection, it is better to cut it. With the cavity lined the patients are more comfortable and do not complain so much of pain at the meatus. Early aeration of the cavity is important and the cavity would be drier than with heavy dressings. In reference to drugs favoring dermatization: scarlet red and boracic acid in equal parts was a very good dressing, but some patients had an

idiosyncracy to the former and suffered intense irritation from its use. In regard to hearing results, covering of the oval and round windows with the graft would help this. The Ballance method of pipetting the air out from under the graft would favor its close application and anchor it in place so that it fitted perfectly.

Dr. Charles W. Richardson, Washington, D. C., stated that in cases treated by skin graft or in other methods of healing there was not the normal subcutaneous lining and there were certain elements lacking which aided in the normal process of carrying out of debris to the external meatus; therefore the detritus remained on the newly dermatized surface. If these cases were not seen and attended to every six months or so, and the detritus removed, there would be discharge, no matter how beautifully the operation was done and how perfect the healing. Was there any method which would eliminate the necessity of continued treatment of these cases?

Dr. George L. Richards, Fall River, Mass., said that this was an anatomical and physiological problem. The underlying stroma was lost, the blood supply was limited, so that normal function was lacking. His patients had to come back every three months or so because one could not get a cavity that one could forget afterwards.

Dr. Ewing W. Day, Pittsburgh said that in adddition to the usual procedure in the bony portion of the tube from the tympanic cavity he cauterized the tube in the cartilaginous portion of the nasopharynx, by the use of the Yankauer speculum and applications of solid stick of nitrate of silver, fixed on a silver probe. This gave more uniform results than without its use.

Dr. L. W. Dean, Iowa City said that he used a drop of olive oil with alkaline solution to clean out the ear, and

taught the patients to do this for themselves and this avoided trouble from detritus.

Dr. S. MacCuen Smith, Philadelphia, said that he had tried to do skin grafting but had not had the success that Dr. Dench had. Dr. Dench was a past master in this technic. In regard to Dr. Richardson's remark, all of these cases must come back to be attended to from time to time. In healthy subjects there was constant skin desquamation, and this must hold true with skin graft. Some few cases remained dry, without accumulations for many years, but these had not the ordinary dermatization. In ordinary cases there would be discharge unless the debris were removed.

Dr. Philip Hammond, Boston, said that his earlier attempts to employ a primary skin graft in the radical mastoid cavity had not been so uniformly successful as the secondary graft, and that for a period of about fifteen years, he had used the latter method. About six or seven years ago, however, influenced largely by the success of Dr. Dench in these cases, he had ventured to again use the primary graft. The method of applying the graft varied somewhat from that advocated by Dench and Ballance, but it was simple and effective. The primary graft as now used has supplanted the secondary graft in his practice. The entire operation is performed in one stage, there are no painful after dressings, and the cavity becomes dry more quickly.

Dr. Joseph A. Stucky, closing said that the operation must be completely done. His subject was post-operative treatment and he had omitted operative points. He had found the scarlet red and boric acid caused pain and he had tried boric acid alone and got much better results and much less inconvenience to the patient. One method to prevent accumulation was to wipe out the ear with one part glycerin to three parts alcohol. He preferred not to use vegetable oils. Closing the Eustachian tube at the outer

end would often leave a puddle of secretions, if closed at all, it should be at the tympanic end.

Dr. Thomas J. Harris of New York said he wanted to give an instance of the value of aeration in healing the mastoid cavity following radical operation. He had a child recently who was absolutely incorrigible during the wound dressings and had to be anesthetized in order to do the dressings. Any attempts to dress the ear properly were made impossible by the fighting and struggling. Finally it was decided to discharge the patient and let her come back later for another operation. She returned in ten days and the ear was seen to be perfecty dry and had remained so. Such a case should have been let alone from the first.

POST-OPERATIVE TREATMENT OF BRAIN ABSCESS.

By S. MacCUEN SMITH, M. D., F. A. C. S., Philadelphia, Pa.

I should like to call the attention of my hearers to the fact that I have been restricted to the post-operative care of brain abscess and am not expected to consider any other phase of the subject. It is obvious, however, that some brief statements of fact are essential to elucidate the text.

In all cases of otitic encephalic abscess formations, the route of selection for their evacuation should be through mastoid exenteration; this enables one to follow the avenue of infection and explore both cerebrum and cerebellum; furthermore, it avoids the necessity, in most instances, of various trephining operations, which expose the dura and underlying structures to infectious influences, and actually do not always provide efficient drainage in the sense of a gravity outlet.

A cerebellar abscess is best evacuated via the postero-internal wall of the antrum. This triangular space is bounded in front by the posterior semicircular canal, behind by the lateral sinus, and above by the superior petrosal sinus, and this area is well exposed by the radical mastoid operation.

As superficial abscesses are usually the result of disease in the posterior mastoid cells and are directly beneath the tentorium and close to the outer surface of the lateral lobe, in hunting for a superficial abscess, therefore, we explore from behind the lateral sinus, whereas we may begin our explorations in front of the sinus to search the cerebellum for deeply seated abscess formations, which are usually the result of labyrinthine involvement and are mostly found in close proximity to the internal auditory meatus.

Should it be deemed advisable to make a counter-opening through the squama, the location for the same can be

readily determined after the abscess cavity has been located through the tegmen. In such instances it is conceivable that irrigation might be employed to advantage.

In cases of unencapsulated abscess, the brain forceps is to be preferred. Personally I have not had any difficulty in entering an encapsulated abscess with this instrument. The opening can be very readily enlarged with a minimum of disturbance by gently separating the blades.

At the time of the first packing, great care must be exercised to manipulate the brain substance gently and just as little as possible. When a drainage tube is used and allowed to protrude, considerable damage may be caused by placing over it flat dressings. Indeed, I have seen several cases where this has been done progress well for a time, but finally develop some complication which I attributed to this undue and unwise pressure. It is much better to place a quantity of loose gauze packing at the outer end of the drain.

Some operators get good results by the use of one or preferably two tubes. The cigarette rolled rubber or gauze drain is used with equal efficiency by other men. Whatever drain is selected (and I personally prefer the cigarette), care must be taken that it is inserted to the full depth of the abscess cavity. If for any reason this must be changed, everything should be ready to introduce a fresh drain to the full depth of the cavity immediately on withdrawing the original one. In the case of a child in whom I evacuated an abscess from three different parts of the brain, I used for each operation—they were about two weeks apart—a double cigarette drain. In this instance the drainage was ample, the patient making a complete recovery, having been employed in a responsible position since her recovery, about seven years ago.

In case iodoform gauze is used,—and this is advisable in almost all primary packings,—we should bear in mind that a continuation of its use over an extended period may cause symptoms of iodoform absorption. If iodoform packing

has been used at the time of operation, and the cavity is large and the pus foul, it is sometimes advisable to replace the same by one or preferably two drainage tubes at the first dressing, and under these circumstances irrigation is indicated.

Personally I have found it necessary to use lavage or irrigation in but a few cases of brain abscess. However, if it is deemed advisable to wash out the cavity, either at the time of operation or subsequently, two tubes must always be used. The tube provided for the return flow should be of larger caliber than that used to introduce the fluid. I wish again to state that I think it unwise to use irrigation at the primary operation, for fear of disseminating the infection. I also believe it unwise to use irrigation at any time as a routine procedure, although it is not only advisable but necessary in some instances, notably in chronic cases. When, in the judgment of the operator, irrigation is called for, the more useful solutions are those ranging from the simple normal salt or boric acid solution to one of carbolic acid, bichlorid of mercury or the Carrel-Dakin solution, the selection being governed by the virulence of the infection.

If the opening into the abscess is sufficiently large, intracranial pressure, under the stimulus of gauze packing, can be depended upon to empty the cavity of its secretion and necrotic tissue. If irrigation is used, the fluid should be under low pressure, and, as above stated, ample provision is to be made for the return flow.

The Whiting encephaloscope is useful for exploring the cavity after the abscess has been opened, and also for the repeated introduction of gauze into the cavity in suitable cases, as it reduces to a minimum trauma or disturbance to the brain substance. Another efficient means of promoting drainage in some cases, and one which causes but little disturbance, is the introduction of the small finger into the abscess cavity at each dressing, until the discharge materially decreases. Finger explorations are especially indicated if symptoms of imperfect drainage become manifest.

I have not had any personal experience with Mosher's copper wire gauze drain, nor the British Army drain, but the principle is sound. It is claimed that they provide an efficient drainage when combined with the use of glycerin, which softens the necrotic brain tissue and facilitates its escape with other debris.

It would seem that the character of the permanent drain must be decided almost wholly by the operator according to the findings in individual cases. There are objections to the prolonged use of rubber tubing because the beating of the intracranial vessels against the same tends to destroy the parenchyma, and yet practically all of our early cases were treated in this manner, with a creditable percentage of success. If we felt quite secure in following Macewen's custom of removing the drain in twenty-four to forty-eight hours, then the above objection would be overcome and the rubber tubing drain would be ideal. However, most of us would exhibit the vacillation of a doubting Thomas anent the abscess cavity having been rendered thoroughly sterile, —a requisite unconditionally essential for the fulfilment of Macewen's ideal.

It has been my custom to change the dressings every day or two, or even twice daily if necessary to keep them clean. The patient is more comfortable by following this procedure, and I am a believer in keeping the wound free from accumulated debris. Furthermore, I think it aids in promoting free drainage by perhaps stimulating capillary attraction, which cannot possibly obtain with a dressing that has become dried and "dead."

The encapsulated form of abscess requires a longer period for healing through the development of granulations, and therefore must be drained for a longer time than the unencapsulated type. The drain here, of whatever selection, must be withdrawn very gradually. Only the operator's personal experience and the conditions of individual cases can determine when to abandon the effort to keep the drainage tract patulous. It is better to continue this somewhat too long than to run the chance of not having

thoroughly evacuated the infectious material from the abscess cavity, as well as the tract leading to the same.

It is not my habit to make especially large dural openings, hence it has not been necessary to make an attempt to suture the dura after the draining process has ceased. Indeed, I consider this an unwise procedure, in most instances, as experience has shown that there will be some escape of fluid even after the methods to promote drainage have been abandoned. Suturing the dura, under such circumstances, would be harmful. The usual methods of protecting the dura from infection before and following the operation, such as walling off with iodoform gauze, etc., should be scrupulously carried out afterwards until the abscess has entirely healed and the wound closed.

If the healing of the bone opening is retarded by a hernia cerebri, an attempt should be made to correct the same by exerting pressure by means of gauze pads made in cone shape and held in position by the usual bandage. In case this does not succeed, the mass, which is mostly granulation tissue, should be excised, provided the hernia does not include the cerebellum or motor cortical region. The exposed surface is then dusted with iodoform or other antiseptic powder, and the gauze pads above mentioned continued. One of my cases presenting an obstinate hernia through the tegmen was treated in this way, with the result that the depression is barely noticeable.

I believe that on account of the seemingly necessary haste in operating, the average brain abscess patient is not properly prepared for such a grave procedure. However essential it is to promote elimination, I deem it most unwise to resort to violent purgation on account of its depleting effect.

It has been my custom before operation, at intervals of eight hours when such time is available, to give high enemas of normal salt solution, and this is continued at intervals of four or five hours subsequent to the operation, as indicated. In the case of the child to whom I referred above, the condition was so grave that we resorted to the administration of normal salt solution intravenously. The benefi-

cial effect of normal salt solution in such cases is truly surprising, and is well worthy of your consideration. It is most important that the patient should be kept quiet and free from all annoyances, even after the serious symptoms have subsided.

As all otitic brain abscess formations are subject to recurrence, the patient should be cautioned not to engage in any activities that increase intracranial congestion for at least one year. This restriction embraces everything that enters into a well-regulated life, including food, drink, recreation, amusement, mental activity and sleep, and of these an abundance of sleep is most essential.

The patient's improvement following evacuation of pus from the brain is truly astounding in some instances. This is especially shown in the way the pulse and temperature will return to normal or above, from their sub-normal state, and even more noticeable is the improved mental condition, the patient emerging from a state of dullness or even perhaps a comatose condition and resuming the alertness of the normal mind, and again taking an interest in his surroundings and recognizing friends, and objects, and even asking for food. The transition is amazing and I know of no other condition in which the changes are so marked and relatively so immediate as in those cases where the functional impairment is due to inflammatory pressure and not to necrotic destruction. The latter cases are always critical and in event of ultimate cure, recovery is prolonged even to several years.

Discussion.

Dr. L. W. Dean, Iowa City, said it was an unfortunate sequel to have a fatal ending in cases that were walking around the ward and feeling well after operation. In all cases he had seen of brain hernia excised, the hernia recurred. It seemed to occur in cases where the finger had been used for palpation, and he did not approve of such a

large incision. It would seem better to make two openings if necessary and use two tubes. Dr. Smith spoke of double drains.

Did that mean a cigarette drain with an outer tube, then gauze and then an inner tube?

Dr. D. Harold Walker of Boston said that a separate opening might be made and the operation would be practically a two-stage one. Sometimes the occipital region was involved by direct extension. Dr. Mosher was using a drain which was kept filled with solution of glycerin, which cleansed the tract. The drain was gradually withdrawn as the cavity became shorter and healed at the bottom. The brain should not be disturbed much. The cigarette drain was apt to become blocked, when the pus was thick.

Dr. Edward B. Dench, New York, said that too much manipulation of the drains was not advisable. The expansion of brain tissue would take care of that point, and the collapsing abscess walls would tend to force out secretions. The use of a suction apparatus would clean out the cavity and do less damage. As to use of iodoform gauze, it would appear better to use Dakin solution as in other parts of the body. This was used in one case of cerebral hernia, and the hernia disappeared. The patient lived six months and died of reinfection. The hernia was a mass of granulation tissue from the brain substance.

Dr. Frank J. Blodgett, New York, said that recovery of mental faculties took place after operation, but if he had to choose his chance of recovery after brain abscess or sinus thrombosis he would choose thrombosis. Even after recovery of faculties, unless kept extremely quiet, the patient was apt to die very suddenly, even after appearing in fine shape. Quiet must be enforced for several weeks.

Dr. Wells P. Eagleton, Newark, N. J., said that operative treatment of brain abscess was still in its infancy. Cases getting well were apt to die, rather suddenly, and there must

be something in the post-operative condition to cause this. In regard to suction, long before Cushing had advocated it in 1918, Dr. Eagleton had reported it in a paper before the New York Academy of Medicine and Collins had said that it would pull the whole brain out. In regard to mental activity, one must realize that a brain that had been the seat of pus formation and suppuration would never really recover its normal condition. One patient who had cerebellar abscess in 1902 was drafted and admitted to the A. E. F. Under the stress of war he had violent headaches, which disappeared when he was allowed to omit excessive mental and physical work. The finger should not be admitted in brain abscess. A wound large enough for the finger, was large enough for brain hernia. Dr. Eagleton said he would not want Dakin's solution if he had part of his brain protruding. One case of hernia had been left alone and kept moist, though the odor was terrible and the whole ward complained, but the hernia got well. Given time enough they would recover. Often, however, brain cases died suddenly because there seemed to be something in localized cerebral substance which predisposed to sudden death.

Dr. Charles W. Richardson, Washington, D. C., said that he operated on a man for brain abscess in 1912 and he made an unusually good recovery. He insisted on enlisting, although advised and begged not to go. He went through six months active service without showing any signs of trouble. Some months after his return he was seized one evening with a vomiting spell and his sister thought she heard a fall. The family found him dead. There was no post-mortem, but the fatal termination was unusual in view of the fact that there was no disturbance of any sort during his whole military service. The character of the affection which caused the fatal ending was not determined.

Dr. George L. Tobey, Boston, said that the Mosher wire drain was a practical device which did not cause disturbance of brain tissue or danger of hernia. The right size and length were chosen and the wire mesh sewn to the

dura and left in four to six weeks. In unencapsulated brain abscess, as Dr. Dench said, pressure would tend to evacuate pus but the middle part might collapse, leaving a residual abscess cavity, but after acute ear disease there was no encapsulation and there was a tremendous flow of pus on removing the dressing. The possibility of multiple abscess should be considered. There were sometimes two or three satellite abscesses demonstrable by the injection of bismuth subnitrate.

Dr. B. Alexander Randall, Philadelphia, said that the question was raised whether the opening should be through the tegmen or through an exploratory opening. He preferred to make a secondary opening through an aseptic field instead of diseased bone. As to drainage, gravity should be used for thick, sticky pus, which would not drain by the capillary method. Had any members followed Macewen's method of removing the capsule itself? His further results had not been published. His first results were 18 per cent cures. In lesions of the arachnoid and brain, douching with pure carbolic had been of use in the speaker's hands.

Dr. S. MacCuen Smith, closing, said that in regard to hernia cerebri, he had excised one case which was largely granulation tissue, applied a cone-shaped pad, and got a good result, but that was probably good fortune and not the rule. In reply to the question of operating through the mastoid or through an exploratory wound, he had had more recoveries when the route was through the avenue of infection than by exploration. In regard to manipulation, it was best not to manipulate the brain too much; still, it was tolerant of rather bold manipulation and one was justified in using whatever means seemed necessary to get rid of necrotic tissue. In regard to complications, sinus thrombosis was the least fatal, then brain abscess, then meningitis. In some cases with retention of pus he had used his finger. In regard to sudden death, perhaps there were ruptures of satellite abscesess. He had seen this in two post-mortem cases.

THE MODERN HEALING OF MASTOID WOUNDS: ITS RELATION TO MASTOIDECTOMY, AND POST OPERATIVE DRESSINGS.

By HUGH B. BLACKWELL, M. D., New York City.

To those of us who recall the long and painful convalescence, with the resultant unsightly depressed cicatrix, which usually attended a simple mastoid operation performed ten years ago or more and from a modern standpoint compares the post-operative recovery of the patient who has recently undergone this procedure, we are impressed by the marked modification generally speaking of these distressing factors of convalescence which were at one time regarded as the necessary incidents of the Schwartze operation.

So great has our progress been along these lines that today one may fairly say that the time required for the healing of a mastoid wound is half or less than half of the period that was formerly considered necessary. At present the dressings are comparatively painless and now instead of healing taking place with an unsightly hole behind the auricle, the mastoid scar more frequently resembles an ordinary incision with little or no depression.

The influences which have brought about this happy change in the convalescence in the mastoid patient are many, but from a technical standpoint we believe can be grouped under the following heads:

(1) The general dissemination of knowledge concerning the technique of the simple mastoid operation, with a resulting improvement in operative skill shown by specialists generally, all macroscopic evidences of diseased bone now being usually removed.

(2) A complete change of attitude as regards the use of gauze in post-operative dressings, formerly this agent was employed in a mastoid wound, not so much for drainage as for the production of pressure, which for some inscrutable

reason was considered necessary immediately upon the conclusion of the mastoid operation. Having filled the wound snugly with gauze the final strip was usually forced into the cavity by the operator leaning with his weight against the dressing. It was not uncommon to use five or six long strips of gauze one inch wide in this manner. A dry external dressing was then usually applied with the first complete dressing on the fifth day. So great was the pain attendant upon the first dressing that it was frequently thought necessary to render a general anesthetic. The dressing of rubber tissue advocated by Dr. Whiting was an attempt to alleviate the pain of dressing. I have not seen it used for a number of years, that is, since tight packing has been discarded. Our modern practice is not to use gauze packing so as to produce pressure, but only in such amounts as to secure drainage in the wound and by light contact with the wall of the cavity stimulate rather than discourage the formation of granulations. We believe that operators generally use today less than one half the quantity of gauze in the mastoid wound than was formerly the case. We have learned that when a thorough mastoidectomy has been performed it is no longer necessary to pack the wound tightly as the diseased processes have been removed now generally speaking by the operation.

(3) The use of more sutures at the conclusion of the operation, now it is customary to suture half or more than half of the wound, the lower half or one third being open only.

(4) A much more tolerant and sympathetic attitude is held today toward the development and growth of granulations in the mastoid wound. The former practice of scraping, excising and cauterizing these loops of blood vessels is no longer practiced with the same religious fervor, they are even frequently permitted to become redundant and a great many of us hold that the wound may be permitted to heal from above downward, below upward, behind forward or from without inward with perfect safety. Since our operative skill has improved and we have become more thorough

in removing the diseased mastoid cells our post-operative dressings have become simpler. Infected wounds have become infrequent. During the era of tight packing owing to the great pressure exerted by the gauze the inside of the mastoid cavity would often present a hard white appearance resembling a tea cup with no evidence of granulation tissue for a period sometimes of two weeks or more after the operation and in cases where a thorough operation is performed should this tight packing, especially in the antrum region, be continued the mucous membrane of the middle ear would grow out into the mastoid wound resulting in a deep post aural depression with a permanent fistula at the bottom or form an air sack underneath the thin cicatrix at the bottom of the wound which would balloon out upon forcibly blowing the nose or tend to break down at future intervals.

(5) Wet and frequent dressings. This subject really comes under the head of improved drainage as it is best promoted by the application of these principles. Mastoids are today dressed more frequently than heretofore. We believe in dressing all mastoids every day and for the first ten days or two weeks employ an external wet dressing as the moist gauze seems to more readily absorb discharge and allay local irritation.

In reviewing the history of this movement for the better and comparatively more rapid healing of the mastoid wound one is impressed by the gradual almost insensible recognition and general adoption of most of the principles here stated. It is interesting to recall some of the attempts made to secure the results which are now commonly obtained by the employment of other methods and if possible to relate their influence on our present attitude and toward the whole subject. We consider that the members of this Society will support us in the contention and belief that the best results from both the surgical and functional standpoints follows the Schwartze operation when a thorough exenteration of all the diseased bone has been performed and that the improvement in healing as shown by the present day mastoid is dependent first of all upon a thorough and complete oper-

ation. Given a clean cavity as a beginning, then we may safely apply subsequently in the process of healing our own individual ideas as to the exact manner of dressing, and provided we do not violate the cardinal surgical principles, all of us arrive at practically the same result. It is not our intention to attempt to instruct those present as to how to dress a mastoid wound, but merely to indicate in a general way the lines along which the best results are now secured and to show the remarkable change in our attitude toward this subject in recent years and the probable reasons therefor. We remember some eight or nine years ago hearing a paper read before this Society in which the operator urged the importance of preserving what he called the capsule of the antrum, or antral capsule. He attempted to attribute the cases of delayed healing, etc., which were so common at that time to the practice of curetting the mastoid antrum. How many of us today would allow this infected mass of bone and tissue to remain undisturbed in the wound at the conclusion of a mastoid operation?

All of us are familiar with the work done by various authors along the lines of straight blood clot healing, that is cases where the posterior wound is sutured entirely and no drainage being employed from the mastoid. I believe that the members here present will generally support me in disapproving of this method of healing.

There was another class of cases differing widely from the above, which unfortunately were called cases of modified or partial blood clot healing. In these cases, however, the posterior wound was allowed to remain open in the lower one-half or one-third and posterior gauze packing was employed in the mastoid from the beginning, perhaps not so much as we use today, however the post-operative treatment of these cases differed only in degree from what is now our usual custom. We believe that in effect a marked analogy exists between what was formerly known as the healing of a modified or partial blood clot case and our own present modern form of healing. Our reason for this belief is based on the fact that immediately upon the conclusion

of a simple mastoid operation, unless the wound is packed tightly, in a short time the cavity will contain more or less blood, where the packing is loose this blood will naturally accumulate and clot in the space between the gauze and the walls of the cavity; the thickness of clot will depend entirely upon the amount of gauze placed in the wound at the conclusion of the operation, and while it may be digested and thrown out subsequently in the process of healing, yet we believe before doing so this blood promotes the development of granulations and shortens the time of healing. It is a matter of no small gratification for the author to observe that the principles which he laid down as necessary for the more rapid healing of mastoid wounds in a paper read before this Society nine years ago, which were in effect: (1) thorough mastoidectomy, (2) light packing, (3) frequent dressing, are today regarded as essentials in the modern healing of mastoid wounds.

Discussion.

Dr. Edward B. Dench, New York, said that he was much impressed with this very clear presentation of the subject which had voiced the opinion of the majority of those present as to healing in the shortest space of time. The reference to the surgeon putting his entire weight on the dressing, was in regard to the speaker's former practice at the time when Dr. Blackwell was his house surgeon. He had departed from that custom since that time as he found firm packing was the cause of slow closure. The form of dressing did not so much matter as getting a good clean wound. The speaker said he carried a strip of iodoform gauze to the aditus and brought it out the lower portion of the wound, suturing the soft tissues over the bone with cat gut sutures, then closing the superficial wound to three-fourths of its extent. Effused blood had not much bactericidal value in his opinion. The tissue flaps are made to adhere to the walls of the cavity and the Michell clips taken out in 48 hours. The gauze strip is then replaced and later a piece of rubber tissue sub-

stituted. The wound would then heal rapidly with very little deformity. When there is exposure of the sinus and dura, two strips are brought out at the angle of the wound, and these are removed at the first dressings. This method had been uniformly successful. In a recent case of mastoid operation where there was rather a dirty wound, the speaker said he allowed the edges to fall together after cleaning the wound and it healed perfectly, without deformity.

Dr. George L. Tobey, Boston, said that he felt the methods in Boston were of a different type in the mastoid operation, so that the remarks of Dr. Dench did not apply to that line of treatment. In Boston it was taught that the tip of the mastoid should not be removed unless sequestrated, so there was no question of flaps. The antrum and zygomatic cells were let alone unless broken down. The two schools had different processes. Dr. Hammond would bear him out in this point.

Dr. Charles M. Robertson, Chicago, said that he was not a member of any particular school, but he had done considerable operating on the mastoid. Formerly when using the burr he found when the bone was nearly polished the granulations did not appear as quickly as in cases where it was left slightly rough. In the latter case granulations appeared faster where the wall of the sinus and inner plate of the skull were smoothed down to a thin plate, cases did not heal kindly, and it was better to remove the smooth bone exposing the soft tissues. In regard to fluffy packing, the speaker said he allowed his cases to bleed moderately and put the packing in while bleeding which seemed to stimulate granulation. Moist dressings were never used on the outside of the wound. A dry wound need not be bandaged except to protect the wound from the pillow. If too many granulations appeared, yellow oxide gauze in vaseline could be used. Caustics never had to be used if the gauze was employed for a day or two. The blood clot method had not given good

results in his hands. He had also tried filling the wound with boric acid, but found that it disappeared, no matter how much one put in.

Dr. Philip Hammond, Boston, said that the former practice was to insist on the wound healing from the bottom. Those who heard Dr. Nichols at last year's meeting saw on the screen lantern slide evidence that bone does not heal from granulations, but from bone cells extending along the periosteum. Continued packing of the mastoid delays union of the periosteum and consequently prevents healing of the bony cortex. The granulations inside the mastoid undergo connective tissue changes and later contract, leaving more or less of a cavity. This result occurs whether the mastoid heals following prolonged packing, or after quick healing of the surface. Whatever method is followed, we must not forget that drainage via the mastoid should not be sealed up while the middle ear is still discharging. The boric acid frequently employed in the mastoid cavity is used because of its antiseptic qualities. It naturally does not persist as a powder. It liquifies and is absorbed in the dressings. A mastoid treated in this way, without packing, with the simplest gauze pad against the external skin edges will quickly heal.

Dr. S. MacCuen Smith of Philadelphia said that he believed in removing the tip, as it might become infected and give subsequent trouble. It would be necessary also to remove infected zygomatic cells. Dr. Blackwell used a gauze strip for a drain, but the speaker used rubber tubing in the antrum, bringing the tubing out at the lower angle of the wound, until drainage from the tympanic cavity ceased. This left a very small depression.

Dr. George L. Tobey, Boston said that the cells in the tip were cleaned out leaving a thin shell of bone, and if there were infection of the zygomatic cells they were removed. It was a question of leaving a very small opening versus a very

large opening. They were satisfied to find the antrum and make a small opening which was entirely different from the New York idea. It was important to decide whether Boston men or New York men were teaching the right principle.

Dr. Frederick L. Jack of Boston, said that he agreed with Dr. Tobey in not leaving cells in the tip, and if the tip was diseased, he removed it. He did not see the necessity of removing the tip in acute mastoid cases.

Dr. John B. Rae, New York, did not see how it was possible to remove all diseased cells without at the same time enlarging the antrum.

In any secreting cavity, boric acid acts practically as a capillary drain, the powder dissolving grain by grain.

Dr. Norval H. Pierce, Chicago, said he made as small an opening in the antrum as possible. He thought the importance of the antrum had been exaggerated; he left it alone, unless the walls were necrotic. Occasionally the tip was removed, but only when hopelessly diseased. He had seen deep abscess of the neck result from removal of the tip, necessitating introduction of drainage tubes beneath the sterno-cleido-mastoid. If possible, an infant's catheter, without side holes, was introduced into the antrum, not for drainage of the mastoid, but for washing the antrum and middle ear each day until the fourth or fifth day, when the cavity is usually found to be dry. The mastoid cavity is packed closely with xero-form gauze. Good healing was obtained by this method, with minimal scar depression. The healing factors were in the blood supply. Removal was only made where there was softening process evident. Nature attended to the tubal cells, in the majority of cases. The less man did to the antrum the better.

Dr. Johnson Held, New York City, said that he spoke for the school which removed that part of the mastoid or antrum which was diseased. If one did not remove disease, one prolonged the time of healing. One could not remove all

dead tissue but it was necessary to remove all the dead bone one could find. One man had spoken of the tubal cells. He believed that those cells were responsible for delay in healing in many cases.

Dr. Max A. Goldstein, St. Louis said that there was no school in St. Louis, although they did an occasional mastoid there. He was impressed with the fact that they ought to be surgeons and not sculptors. The first principle of surgery was good drainage. The antrum was more or less inviolate, but if there was surgical indications, every surgeon ought to follow them up. Neither Boston nor New York could prescribe a stereotyped method. These things had been under discussion for 20 years. It was a question of plain surgery and surgical judgment on the part of men of experience. There was no reason for removing healthy bone and tissue serving definite anatomical purpose unless the necessity were imperative.

Dr. J. E. Logan said that the school question had grown so that he expected to find one in Kansas City when he got back.

Dr. Arthur B. Duel of New York, said that the discussion reminded him of a story of an Irishman, who listened patiently to the experiences of two hoboes who were discussing their adventures around the world. He asked "Did ayther of ye iver have delirium tremens?" and being indignantly told "no" he said "Thin nayther of ye've niver bin anywhere and niver seen nuthin." It was illuminating to find that all the different "schools" had come to about the same conclusions as to results regardless of the method of operation or after treatment. A large proportion of mastoids would recover if the operator simply broke through the outer bony walls thus permitting drainage. It was a question of giving vent to confined pus which was destroying the cell walls. In Germany many years ago the speaker said he had seen Breut tear a hole through the cortex, break down a few pus cells, tuck gauze in, keep the wound open,

and promote drainage. That was all he ever did in acute mastoids in children and he got results. The speaker said he continued to insert rubber tissue for drainage and remove all diseased cells The discussion showed that cases would get well under many different kinds of surgery, and of dressing.

Dr. J. J. Thomson, Mt. Vernon, said that he got better drainage from the middle of the wound than from the lower angle. He brought the muscle and periosteum together and closed the greater part of the cavity.

Dr. Hugh B. Blackwell, closing, said that the discussion had been lively and that he would refrain from saying anything about the various schools, except that to his mind the subject under discussion was largely a matter of drainage as applied to pre-operative treatment, possibly in New York they were not so quick to operate and allow the case more time to drain out per canal prior to operation. Should such a case come to operation it naturally follows that a more thorough mastoidectomy is required, the reverse of this is of course true if in certain communities it is the custom to operate earlier in mastoiditis. In this connection he wished to say some years ago he had been much impressed by a specimen which showed anatomically the negative picture of the mastoid which had been prepared in this manner: hot liquid amalgam had been poured into the external auditory canal of a dry temporal bone. Subsequently the entire bone including the intracellular trabaculae was dissolved with strong chemicals which left nothing but a complete metal cast of all of the cavities of the temporal bone, including the internal ear. The intimate association and gross communication between all of the mastoid cells was beautifully revealed by this specimen. In cases of purulent meningitis developing in connection with mastoiditis the pathway of infection to the brain is usually not demonstrated, in view of these facts he believes that in the present state of our knowledge it is better to perform as thorough an operation as is possible. He believes all are agreed in removing all

evidences of disease. Dr. Dench said that at the conclusion of the operation he squeezed all the blood out of the wound, but surely within a few minutes there would be as much blood as ever in the cavity. Dr. Robertson did not think that the use of moist external gauze dressings constituted good surgery. However mastoiditis is in itself an infection and it is orthodox surgery to employ wet dressings until the signs of local irritation subside. In regard to the use of rubber tissue, years ago he did employ rubber tissue as recommended by Dr. Whiting to eliminate the pain of dressing. He soon discontinued its use however, as on the removal of the rubber tissue he usually found a thin layer of slough lining the cavity.

It is indeed remarkable that no general attention has been called to the improved results that are secured today in the healing of mastoid wounds as against those of eight or ten years ago. He considers that the rapid healing, diminished pain of dressing and better cosmetic appearance may be regarded as one of the most notable advances of otitic surgery of recent years.

OPERATIVE PROCEDURES UPON THE INTERNAL JUGULAR VEIN IN CASES OF SINUS THROMBOSIS OF OTITIC ORIGIN.

By EDWARD B. DENCH, M. D., New York, N. Y.

A thrombus within the lateral sinus following an inflammatory condition within the middle ear is naturally a condition of the utmost gravity. It is not surprising, therefore, that much has been written regarding the proper surgical management of this condition. When sinus thrombosis was first recognized as a distinct pathological condition giving rise to well marked symptoms rendering its diagnosis possible, surgical procedures were immediately instituted for its relief. The simplest of these procedures was the simple evacuation of the clot from the lateral sinus and the securing of free bleeding both from the distal and proximal ends of the vessel, the arrest of this hemorrhage by the insertion of gauze plugs either between the vessel wall and the overlying skull or within the lumen of the vessel itself and the subsequent dressing of the wound. This method of treating a thrombus of the lateral sinus would seem rather crude at the present time.

While the procedure just mentioned will be successful in a certain number of cases the dangers incident upon the entrance of minute emboli into the general circulation upon freeing the clot in the bulb has rendered it advisable in the opinion of most surgeons at the present time to leave the sinus undisturbed when a diagnosis of sinus thrombosis is made until the infected area is permanently cut off from the general circulation by previous surgical procedures upon the internal jugular vein. The question which then arises is should the internal jugular be simply ligated or should the vein be excised. It seems to me that each procedure has its place. A consideration of this subject will be fraught with much more good if we consider the work of various oper-

ators along these two lines rather than to attempt to make a hard and fast rule that one procedure is to be used to the exclusion of the other.

The choice of procedure will, it seems to me, depend upon several factors: First, upon how soon the operator decides that interference with the vein is necessary, this carries with it naturally the question of how soon an absolute diagnosis of sinus thrombosis can be made. We all know that a positive blood culture in a case of suppurative otitis with symptoms of sinus thrombosis renders the diagnosis absolutely certain. Secondly, how early in the course of the disease has this diagnosis been arrived at. Third, a consideration of the actual pathological process which occurs in these cases.

Taking the third question, that is the course of the pathological process, an investigation of a number of specimens of diseased jugular veins removed in cases of this character show that the condition is one really of an acute phlebitis. In other words, the clot does not form first and the vein wall become subsequently involved, but the vein wall becomes involved first and the clot is a direct result of this involvement. Microscopic examinations of veins upon section show without exception an infiltration of the vessel wall with pathogenic organisms far below the level of the clot. From this fact that the wall of the vessel becomes first invaded and that then the clot forms and that the formation of the clot is a pathological process secondary to the invasion of the vessel wall, it is manifestly evident that any operative procedure upon the internal jugular vein must secure the isolation of the infected area of the vein from the general circulation, in spite of the fact that in order to secure this it may be necessary to interfere with the vein at a considerable distance below the level of the clot.

Taking the other two questions as to how soon the operator decides to interfere with the vein and at how early a period the diagnosis can be arrived at. In cases where a positive diagnosis has been made rather late in the course of the infection it would seem rather perilous to presume that simple ligature of the vein in its upper portion would be sufficient

to cut off the infected focus from the general circulation. If the surgeon is willing to make a diagnosis of sinus thrombosis upon the first appearance of a high temperature, say 103 or 4 or 5, after a simple mastoid operation with exposure of the sinus, then perhaps simple ligature of the vein might be considered the ideal operation. Most of us who have had considerable experience in cases of this character know that particularly in children an abrupt rise in temperature following a mastoid operation is not at all uncommon. If upon this single rise or upon a second rise the vein is to be dealt with surgically, many cases will undoubtedly be unnecessarily operated on while the favorable statistics of the procedure will correspondingly increase. Theoretically, it would be safer in every case in which the sinus was exposed at the time of the mastoid operation, and in which the wall of the sinus appeared unhealthy, to put a ligature about the internal jugular vein at the primary operation, and in this way prevent almost certainly an infection of the blood stream. Such an operation, however, is manifestly unnecessary in a large proportion of these cases and all of us, I think, agree that it is unwise to interfere with the vein until actual signs and symptoms of sinus involvment manifest themselves.

One or two abrupt rises in temperature are in my mind absolutely insufficient evidence, particularly in children, that the sinus is involved in the presence of a negative blood culture. The same may be said of the septic appearance of the patient. A characteristic differential blood count with leukocytosis of from 10,000 to 16,000 and a polymorphonuclear count of from 70 to 77 or 8, while strongly confirmatory of sinus thrombosis is not absolutely diagnostic.

Early diagnosis would, therefore, seem to be impossible in a large proportion of cases. A positive diagnosis can not be arrived at for at least two or possibly three days in the absence of a positive blood culture, and during this period the infection may be steadily spreading along the wall of the vein. At the time of interference, therefore, in a large

proportion of these cases we must look for a rather extensive involvement of the wall of the vein, and it would be rather a difficult question for the operator to decide whether a ligature placed high up will be sufficient to control this pathological process.

One or two cases which occurred during the last year rather bear out this point of view. In one case a man was operated on in a distant city for an acute mastoiditis. Ten days after the operation he developed intermittent high temperature, otherwise he felt fairly well. He was brought to New York and I saw him on the fourth day after the beginning of the fever. A blood culture was negative, but on the night of his arrival in New York his temperature was 105°. In spite of the negative blood culture I excised the jugular the next day. No clot was found in either sinus or jugular but the wall of the vein showed a beginning parietal clot. This man made a perfect recovery after a rather stormy convalescence. In this case a ligature placed about the jugular would probably have failed to control the systemic infection and the outcome might have been different. In another case on my service at the hospital, and operated upon by one of my assistant surgeons, a child about five days after a radical operation developed a remittent temperature, blood culture was negative and a physical examination revealed no signs of lung involvement. In the absence of other causes for the temperature I advised either a removal or ligation of the jugular. The jugular was tied above the facial and a small section of the vein removed. The vein on microscopic examination was perfectly normal. The child's temperature fell on about the ninth day and the child made an uninterrupted recovery. This case was undoubtedly one of central and unrecognized pneumonia. Had the vein not been examined microscopically it would have been probably classed as sinus thrombosis, with ligation of the jugular and cure.

In doubtful cases where no other cause can be found for the temperature and in the presence of negative blood cul-

ture, if operation is decided upon early, ligation may be the operation of preference, particularly in patients whose physical condition seems to contra-indicate a long operation. In many of these cases, however, the subsequent history of the case after interference with the vein proves conclusively that the lateral sinus was not the source of infection. A rather interesting example of this was seen in consultation this year. A young girl sent to a colleague for removal of the tonsils was found to have an acute inflammation of each antrum. The surgeon hesitated to operate on the tonsils on account of the suppurative condition of the antra and the possible danger incident upon anesthesia. Irrigation of each antrum was done, and subsequently the patient developed an acute otitis upon each side. Both drum membranes were incised and there was a rather scanty discharge from each ear. About a week after the drum membranes were incised the temperature shot to 105 following a chill and then fell to normal. These chills and elevations of temperature occurred daily and I was asked to see the patient. Blood culture was negative, both ears seemed to be draining freely, an X-ray of the left mastoid showed a cloudy mastoid with no breaking down, an X-ray of the right mastoid showed a clear plate. I advised an operation upon the left mastoid with exposure of the sinus and daily blood cultures. The sinus was normal at the time of operation and the temperature fell and remained down for thirty-six hours, at the end of which time the chills and remittent temperature reappeared and the blood culture still continued negative. The patient came from Central America, but gave no history of previous malarial poisoning and no plasmodium was found on repeated blood examinations. I then advised ligation or excision of the jugular, depending upon the appearance of the vein and sinus at the time of the second operation. Both structures appeared normal and prolonged anesthesia being deemed unwise on account of the accessory nasal sinus condition simple ligation of the vein was performed above the facial. Again the temperature remained down for

thirty-six hours and then the remittent temperature and chills reappeared. We were then confronted with the possible necessity of ligating the opposite vein. In sheer desperation I advised the use of large doses of quinine, twenty grains to be in the circulation three or four hours before the expected rise in temperature. This was done and no chills or temperature elevation occurred. The administration of quinine hydrochloride intravenously prevented any further temperature elevations. This case might well have been classed as one of sinus involvement in which ligation of the vein was followed by cure.

I cite these cases simply to show that in many instances an early diagnosis of involvement of the sinus and a subsequent disappearance of the symptoms by placing a ligature around the vein may give statistics that are not exactly correct. I do not believe in making a diagnosis of sinus thrombosis with one or even two rises in temperature in the absence of a positive blood culture, and this is particularly true in children. In these little patients a central pneumonia will frequently go for days without giving physical signs, and the temperature in these cases simulates very closely that of sinus thrombosis. In fact I know of no way of making a differential diagnosis. I should state roughly, therefore, that my opinion would be that in early cases where the surgeon decides to operate, that ligation of the vein should be seriously considered. It must be remembered that when the vein is ligated that the ligature must be placed about the vessel above the facial vein. If this is not done, and if the vein is ligated below the facial, pathogenic organisms will be carried directly from the infected wall of the jugular through the facial vein to the corresponding vein on the opposite side and thence into the opposite internal jugular. Ligation below the facial vein, therefore, practically does not safeguard the patient at all from the systemic infection.

While on the cadaver it is a very easy matter to place a ligature about the internal jugular above the level of the

facial vein, in a case of sinus thrombosis the operation is not quite as simple. Very early after infection of the wall of the vein we have enlargement of the lymphatic glands overlying the vessel. The glands first involved are those at the angle of the jaw just over the point where the facial vein enters the internal jugular. This renders exposure of the vein above the facial rather difficult, and while usually the vein can be exposed and tied in this region more quickly than the vessel can be excised from a point beneath the omo-hyoid to a point above the entrance of the facial vein, the difference in time between the two operations is not as great as might be imagined, especially when the glands are very large. Moreover, in all of these cases where the glands are enlarged I should hardly feel justified in simply ligating the jugular above the facial. In addition to placing a ligature at this point I think that it is always wise to tie off the lingual and facial veins, and also the communicating branch with the external jugular, if this is present. Such a procedure isolates the infected area fairly well, and if the vein above the facial appears normal at the time of operation, this operation is no doubt an excellent one for certain cases.

Of course, from my own experience I feel much safer to excise the vein rather than simply to tie it. I believe that excision is always safe while simple ligation is undoubtedly safe in some cases, but may not be efficacious in all cases. One unfortunate case that came under my observation seemed to demonstrate this fact. An infant operated upon for an acute mastoiditis was operated upon two days after for sinus thrombosis, although the bony wall covering the sinus had been normal at the time of the first operation. A large clot was removed from the sinus and free bleeding from both extremities of the sinus occurred. Forty-eight hours later a septic temperature made it necessary to explore the vein and a clot was found in this vessel extending to below the level of the clavicle, where the process had extended through the vein while the bulb had remained free. In a second case, that of a diabetic, the sinus had ap-

peared normal at the time of operation. About a week later there was free hemorrhage from the sinus when the wound was dressed. The patient then ran a septic temperature, the blood culture was negative. The jugular was exposed under a local anesthesia and a firm clot was found extending from the base of the skull to below the omo-hyoid muscle. The vein was excised under local anesthesia but the patient unfortunately died.

My conclusion would be that no hard and fast rule can be laid down in dealing with cases of sinus thrombosis. Each case is a problem by itself and the surgeon must use every diagnostic method possible to arrive at an early diagnosis, and then employ the operative procedure which seems best adapted to his particular case which might be somewhat as follows: Ligation when the diagnosis is made early and when the vein and sinus seem but little involved upon exposure; excision where the diagnosis is made later or where the vessel walls are manifestly so clearly involved as to preclude the possibility of a cure by ligation.

In concluding this subject it may be interesting to record my own statistics. My own records show 97 cases of sinus thrombosis. This includes both cases in which the jugular was ligated or excised, and also certain cases in which the sinus was simply opened and the clot evacuated, free bleeding being obtained from both the proximal and distal ends of the sinus. Of these 97 cases 24 died, giving a mortality of 24 7/10%. Out of 66 cases in which excision of the jugular was performed 19 died and 47 were cured. Many of these deaths occurred from complicating diseases, such as diabetes, pneumonia, and in one case brain abscess. The total mortality was 28%, giving a cured percentage of 72%. You will understand naturally that if ligation is performed early in doubtful cases the resulting favorable statistics for the operation will be much higher than these, but the question as to the correctness of the diagnosis will always remain.

THE IMPORTANCE OF EARLY LIGATION OF THE JUGULAR VEIN IN INFECTIONS OF THE LATERAL SINUS OF AURAL ORIGIN.

By D. HAROLD WALKER, M. D., Boston, Mass.

The importance of infections of the lateral sinus of aural origin has been emphasized, and the symptoms fully described by several writers so very recently, that it is my desire, at this time, to bring to your notice the results of the ligation of the internal jugular vein for lateral sinus thrombosis, and infections of the blood stream, in about one hundred cases operated by various members of the staff of the Massachusetts Charitable Eye and Ear Infirmary, and attempt to show the advisability of early ligation.

In looking through the literature upon the subject of Lateral Sinus Thrombosis, one is impressed with the importance most writers give to certain cardinal symptoms, and many of the cases are reported because of the apparent rareity of all of the classical signs. Wherever there is a possibility of a difference in the opinion in the treatment of these infections, one must realize that different observers in different latitudes and climates, may have very variable strains of infections to deal with, and the experience of one man may vary necessarily from another. Our New England climate, for instance, is extremely severe, with rapid changes in temperature, so that any one who expects to resist such conditions must maintain an active immunity in order to be really well. Upon the other hand, those who do succumb are generally very ill; they "go the limit," one may say, and an infection once gaining a foothold immediately assumes serious character, because of the suddenness in which complications may arise. These cases, to which I refer, entered the hospital in all stages of infection. Some showed complications while under observation, even before the mastoid was opened. In others complications developed

shortly after the mastoid operation, and a number were operated upon immediately after admission. One is impressed with the great variation in symptoms. All showed a septic temperature, generally with a morning fall and an evening rise, although in some recent instances the high point consistently came at midnight or the early morning. Chills or chilly sensations were fairly constant. Severe headache occurred in about 50% of the cases, and nausea and vomiting in about 25%. Metastasis occurred in about 20% and the Fundi showed changes in about 25%. The leucocyte count varied greatly, being as high as 30,000, and in some instances occurring this spring being under 10,000. The average is about 15,000. Simple ligation of the jugular vein was done in all but one case, for some reason that one submitted to resection of the vein as well. Of the uncomplicated cases of thrombosis or septicemia, 83 in number, 66 recovered, or about 81%. Of these 83, 52 showed either a thrombus or free pus when the sinus was incised, and of the remaining cases, although the sinus bled when opened, many of them gave the most classical symptoms before operation, even metastasis. In other words, neither the symptoms nor the condition of the mastoid was any indication of the condition of the sinus. As an example: Case No. 40, simple mastoid operation; sinus exposed at the operation appeared to be normal. The next day, a chill and a sudden rise in temperature. The vein was ligated and the sinus opened, and fluid pus was found. Recovery in four weeks: Another example: Case No. 48. Patient under observation five days before mastoid operation. A chill and a sudden rise in temperature occurred, followed by immediate operation. The cells were not broken down. Sinus was opened and found thrombosed. Internal jugular ligated. Recovery. In a private case, that of a boy of 16 years, the only symptoms were a septic temperature and a moderate leucocytosis for three weeks. Both middle ears were affected with tenderness of both mastoids. No edema. The prolonged septic temperature reaching 105.5° made intervention necessary. It was impossible to determine from any

symptoms which sinus was affected. The ear which had been discharging the longest was chosen and the mastoid opened. The sinus was uncovered and appeared normal. The other mastoid was then done, and the sinus found to be thickened. It contained a thrombus. The vein was ligated but the boy succumbed finally from a myocarditis. It is interesting to note that in two cases of accidental opening of the sinus, thrombosis occurred, requiring ligation of the vein. It is not infrequent to meet with a distinctly meningeal type of case. There is retraction and tenderness of the neck, a semi-comatose condition, and an increase in the cells of the cerebrospinal fluid. There were four cases of this type, two with recoveries after ligation and two succumbed to meningitis, where the sinus was found thrombosed at autopsy. A striking example came to my attention recently: A child, 3 years old, had an attack of acute inflammation of the middle ear. The temperature continued very high after paracentesis and was placed in a Providence hospital. No complications were found, and afterward it was brought to Boston to one of our best pediatricans. He found absolutely nothing wrong other than a questionable bulging of one drum membrane and a temperature of 105°. He suspected a sinus thrombosis and referred the child to me. I incised the drum and succeeded in having the child taken to the infirmary. Meningeal symptoms promptly arose and death occurred after five days. At the autopsy a thrombosis of the right lateral sinus was found.

When one considers the relation of the middle ear with the jugular bulb, it is surprising that the infection does not find its way to the arachnoid by direct extension more often than it does, and I cannot but feel that the majority of meningeal infections of aural origin are secondary either to a lateral sinus infection or that of the jugular bulb.

In the 12th edition of "Heine," "Operations Upon the Ear," published 1906, he speaks of the occurrence of streptococci in the cerebrospinal fluid in cases of lateral sinus thrombosis. Is it not likely that many of the cases of cure of meningitis by operation were primarily lateral

sinus thrombosis with meningeal irritation, and when nature walled off the infection resolution resulted? The cause of death in the majority of the cases under discussion was septicemia. Meningitis occurred in five, lung abscess in one, and thrombosis of the cavernus sinus in two.

What are we to learn from this incomplete dissection of these histories? Certainly one cannot depend upon any fixed or cardinal set of symptoms, as some of the most advanced cases gave only a temperature, and occasionally a chill. Optic neuritis is of great assistance when present with other signs, headache is fairly constant but is too commonly a symptom of any general infection to be of great use. The white count is so variable that one cannot place any reliance upon that, and a blood culture may be positive in any case of acute infection, or negative where there is a walling off and an enclosed sinus abscess. The only positive signs are a septic temperature, possibly a chill. If there are any objective indications, such as edema behind the tip of the mastoid or over the emissary vein, and tenderness of the jugular vein, then the diagnosis is rendered more certain, but given a case running a septic temperature when all other possible causes can be reasonably excluded, I feel that one is justified in ligation of the internal jugular vein. The operation is practically devoid of shock, it requires very little time, and under gas oxygen anesthesia the after discomfort is minimized. When one realizes the serious complications which can arise with so little indication of their presence, to wait until definite and absolutely certain signs of a thrombosis occur, is open to serious discussion. In cases which come under one's notice in an advanced stage of infection, where there is a definite thrombus extending through the vein, or where there is pus in the sinus, whether resection of the vein is indicated is open to discussion. It has been the experience of my colleagues and myself that simple ligation, with a thorough opening of sinus, and drainage established, are sufficient. Our procedure is to ligate first just above the facial vein, then explore the sinus. If a clot is found, a large opening is

made in the sinus wall, and as much of the clot cleaned out in the direction of the bulb as is possible. Personally, I do not believe in disturbing the distal end too far toward the torclea. If nature has walled off that end, I see no reason to force her to form another barrier. If at the point of ligation a thrombus is found, then one if he wished can ligate just above the clavicle, cut the vein and establish drainage through the wound. With the patient in the recumbent position, and a piece of the sinus wall removed. drainage is easily maintained, and there is little opportunity for any general infection. Resection if done fully means a long and tedious operation, and with a patient who must be in a serious condition, if resection is thought necessary the shock would do more harm than that occasioned by mere absorption after simple ligation. As I stated in the beginning, different observers have different methods, and one that has proved fairly successful in Boston might be wholly inadequate elsewhere.

In conclusion, experience has taught us that in many cases which ended fatally the fault lay in attacking the complications too late, after general septicemia had begun: that if ligation could have been done early, the percentage of recoveries would have been much higher. Whether to resect the vein or not rests with the individual operator and his personal experience. If one has found that results are better, and the percentage of recoveries larger than by simple ligation, naturally that procedure is preferable.

Discussion.

Dr. Charles E. Perkins, New York, said that if this was to be a discussion of ligation versus excision, he would stand on the side of excision. From two cases which he had recently observed, he had been impressed with the inadequacy of ligation. In the first, a soldier in France, there had been an abscess in the neck, communicating with the vein, which was thickened and thrombosed to below the clavicle. In the second, a girl of 6, there was pus in the

vein to the level of the thyroid vein. In neither of these patients would ligation have been of any use. With excision one could deal with these patients successfully. Both recovered.

Dr. George L. Tobey, Boston, said that he was to read a paper which would touch Drs. Dench and Perkins in very sensitive spots. He would ask if Dr. Dench had ever seen ill results from tying below the facial? It had been supposed to be dangerous. Cases of extension from the facial vein had not been encountered, but one case had been seen of apparently metastatic infection in the lower lip.

Dr. J. J. Thomsen, Mt. Vernon, said that ten years ago he started to ligate instead of excise the vein, taking a point below the omohyoid, which was easier and required a short incision. The mastoid was exposed over the facial and lingual vein; he had never seen trouble occur from this method. He did not know why there should be more trouble from the facial than in inferior petrosal.

Dr. John B. Rae, New York, talked of the value of culture of the urine in the diagnosis of sinus thrombosis. Blood culture is frequently negative, particularly in children, as the amount of blood withdrawn is small and the organisms circulating at the moment may be few in number. In addition, the culture may have been taken at the time least favorable for obtaining a positive result. Culture of the urine, in the absence of pyelitis or other kidney lesion, may give a positive result. If then, in the absence of kidney complications, the organism which had been found in the middle ear and antrum can be recovered from the urine, a diagnosis of infection of the blood stream from the aural lesion may be assumed.

Dr. George L. Richards, Fall River, said that the whole question rested on the quickness with which one made the diagnosis. If made early, ligation was sufficient. It

was perhaps better to take a chance on tying the jugular early. It entailed less risk to the patient. He could recall one case in which there was high temperature and low pulse, somewhat suggesting brain abscess. The jugular was tied and a primary bulb thrombosis formed.

Dr. Thomas J. Harris, New York, said that this was a question of ligation versus excision. Dr. Dench said that early cases were not suitable for excision, while in such cases with involvement of the vein Dr. Walker apparently advised ligation instead of excision.

Dr. Philip Hammond, Boston, said that, as Dr. Walker has pointed out, there have been many cases of sinus thrombus treated at the Massachusetts Charitable Eye and Ear Infirmary, practically all of them by simple ligation of the jugular, followed by a free drainage of the sinus contents. He recalled at least two cases that had occurred on his service several years ago,' where there was a distinct thrombus extending below the clavicle. In each case, a ligature was placed on the jugular as far down as could be reached, and both cases recovered. While the result obtained in these cases was good, it was, of course, no argument for leaving an infected vein in the neck.

Dr. B. Alexander Randall, Philadelphia, said that these processes began with phlebitis, but there was a difference between the acute and chronic cases. Possibly in suppuration, excision would lessen danger to the patient, in spite of increased shock. In the chronic cases, some manifestations demanded excision,—such as unrecognizable vein or purulence. The differential count should be of help in these cases, a high polynuclear count indicating that the patient needed aid in overcoming the infection. The question of metastases was important, either of those immediately near the neck, or in fact anywhere in the body.

Dr. F. P. Emerson, Boston, said they were discussing three things under one heading: first, phlebititis; the second

stage, thrombosis; the third stage, septicemia. Dr. Walker advocated ligation before the last stage takes place. Dr. Dench had discussed septicemic cases. In the first two stages one would not get much from blood culture. It was positive in the third stage. Leucocytosis was a question of resistance of the patient. Some patients had very little come back and low leucocytosis. With patients lying in bed the drainage with ligation was good.

Dr. Edward B. Dench, New York, closing, said he was gratified at the elaborate discussion of this topic. They were here to learn, and his paper was not polemic. Excision was not necessary in every case, and the best procedure must be studied. Curing the patient was the important thing. In regard to chill, he had noted that in about 50 per cent., and he relied on the intermittent temperature as a more constant sign. Dr. Walker mentioned delirium; he had not noticed that, but sometimes menigeal symptoms occurred. In regard to the differential count,—the polys were usually from 70 to 76 per cent., while a white cell count of about 12,000-18,000; the leucocytosis represented the resistance of the patient, and the polys the amount of poison. He would like to know if Dr. Walker did not open the sinus in every case of this character operated upon. He thought sometimes the clot disappeared with the hemorrhage. He had had no experience in tying below the facial vein. The collateral circulation being very free, if one did not tie off everything, it would wash through and cause systemic infection. Infections from the toricular end of the sinus were rare.

Dr. D. Harold Walker, closing, said he felt it an honor to be associated with Dr. Dench in this discussion. In regard to Dr. Tobey's point, there was an unusually large anastomosis between the facial and the ophthalmic vein and also the external jugular. It was necessary to make a large window when one found the vein thrombosed, then one could go lower and tie off the point. If the thrombus broke

down the drainage would be good, because the patient was in the recumbent position. He had not had any experience with excision because he had obtained good results with ligation at the clavicle and drainage above. If one got better results with excision, by all means one should do so; it was merely a question of common sense. Early ligation, however, should produce better results. In regard to meningitis, he had had two severe cases; they were not extreme, but there was decided meningeal infection. Some cases of meningitis were undoubtedly due to thrombosis not demonstrated before death. Dr. Day reported nine cases of recovery without any operation. In regard to blood cultures, his statistics were weak, and it was his impression that blood cultures should not be relied upon too much. Bacteria varied a great deal in virulence, and different strains were found in different parts of the country.

PERCEPTION DEAFNESS.

By FRANCIS P. EMERSON, M. D., Boston, Mass.

Etiology—In considering the etiology of non-suppurative deafness there have been two theories that have divided otologists into camps. First, we have those who have believed in the theory of negative pressure, and second, those who have believed in infection as the primary cause. Of late years the advocates of infection have been the more numerous. Judging from the treatment generally accepted by otologists it is fair to assume that the second class have believed that deafness was the result of an acute infection that damaged the conduction apparatus and then ceased to be a factor in the further progress of the disease. The deafness was then progressive by further attacks of tubotympanic catarrh that was the result of a fresh infection. The writer wishes to take issue with this position and to claim that all deafness is the result of a deep infection in the lymphoid tissue; that the infection then exists as a chronic focus subject to acute exacerbations; that the resulting deafness does not occur from the extension by continuity of the infected tissue through the tubes and middle ear so much as it is the result of a toxine acting on the perception apparatus. That is we have perception deafness from the beginning that can be demonstrated throughout its course until the end result, which is either nerve degeneration or perception deafness, without regard to the tissue reaction in the middle ear.

If we carefully analyze our histories of chronic deafness we find in one class that there was otalgia in childhood, and in these cases we all attribute the middle ear involvement to a blocked tube secondary to infection of the lymphoid tissue. Until adolescence, lymphoid tissue predominates, and beyond this period it is replaced by fibrous and mucoid elements (Jonathan Wright). With the change in structure the lymphoid tissue undergoes retrograde changes, becomes

less functionally active and is therefore more susceptible to infection. The next class of cases follow the infectious diseases and are characterized by a more virulent and deep infection which, in many instances, results in chronic foci subject to acute exacerbations throughout life. For a long time the foci may remain as a walled-off local process. If the resistance of the host is lowered, the virulence of the organism increased, or necrotic tissue changes destroy the leukocytic barrier, then we have systematic complications with remote tissue reactions. Why this takes place in a particular joint, endocardium, or middle ear, we do not know, but once having occurred the tissue reactions go on in the same organs indefinitely. The history clearly shows that the patient was never deaf until a certain time when they had influenza, measles, diphtheria, etc. Following this infection the deafness was progressive and especially noticeable after acute exacerbations. Cultures of the throat show some form of virulent bacteria present in the lymphoid tissue. The vessels of the anterior pillars are injected, the tonsillar crypts contain pus, mucopus or debris. The secretions of the pharynx are changed, i. e., there is a low grade pharyngitis and the deep cervical glands under the angle of the jaw are enlarged. With acute exacerbations of the focal process these glands are sensitive on palpation. While there is a tendency for the infection to extend to the lining of the Eustachian tube with gradual extension to the middle ear, the gross tissue changes are of only secondary importance to the accompanying infection in the problem of deafness. The conduction apparatus, when considered as a mechanism for the protection of the nicely adjusted perception apparatus, is wonderfully arranged. With the tissue reactions following a focal infection due to a particular strain of bacteria in all forms of deafness, there seem to be changes in the conduction apparatus analogous to those taking place in other organs which are damaged as the result of a similar focal infection. In all cases there is a functional

disturbance of the perception apparatus, and in the organ of hearing, as in other organs, the restoration of function is dependent on whether its special nerve mechanism is irreparably damaged or only functionally disturbed.

Many otologists since the days of William Meyer have recognized the importance of removing infected adenoids and tonsils. Many now recognize that adults carry infection throughout life in the lymphoid tissue with an accompanying low-grade pharyngitis. It is not only necessary to remove these foci in cases of deafness, but all contributary infective areas in the teeth, sinuses or chronic mastoids, that drain through the lymphatics. In a given individual the balance between the infective agent and the natural immunity of the patient due to the bactericidal and antitoxic powers of the tissues, blood plasma and cells, varies markedly. When this balance is once disturbed by any cause that lowers the resistance of the host, and systemic infection results, the remotely involved tissue becomes sensitized, and less toxine than would affect a normal individual suffices to continue the morbid process. This makes the presence of innumerable saprophytes in the mouth and pharynx and such pathogenic bacteria as the streptococcus mucosus, viridens and hemolysins, the micrococcus catarrhalis, pneumococcus, bacillus mucosus capsulatus, grippe bacillus, diphtheria and pseudo-diphtheria bacilli, which may be found in infected lymphoid tissue and the sinuses, particularly dangerous to the carrier. Furthermore, such infectious foci of the head may be associated with secondary infection of the lymph nodes of the neck and mediastinum. These patients have low resistance, and over-work is as potent in activating the focal process as is exposure. With these conditions present, and judging from the analogy of similar tissue reactions in other organs, and from clinical experience, it is the conviction of the writer that deafness is the manifestation of a systemic infection resulting from a special strain of bacteria, the toxine acting on the perception apparatus from the beginning and continuing so to

act until the terminal stage of marked perception deafness or nerve degeneration, the accompanying gross tissue changes in the conduction apparatus playing but a minor role in deafness.

Deafness may be defined as an impairment or loss of tone perception. Corti's cells are supposed to constitute the clearing house where sound waves are differentiated and conveyed through the auditory nerve to the cortical centres. It is at the acoustic centers that wave impulses are interpreted as sound. We say then that anything that obstructs or interferes with these wave impulses reaching the perception apparatus results in deafness. Is this the true explanation? Let us assume that deafness has its beginning in infection. Now, not all infections are followed by impairment of hearing. In some cases of infection in which tone perception is impaired there is a complete restoration of hearing with the clearing up of the infection. These are the few cases in which inflation and the usual methods of treatment of the Eustachian tube are indicated. There are deep infections, however, that do not clear up with the subsidence of the acute symptoms, either from the virulence of the infection, the lowered resistance of the host, or poor drainage, and these infections cause most of our cases of deafness. These chronic foci may, with acute exacerbations, for a long time give only local symptoms. When the local barrier is once broken down we have systemic manifestations and but mild local symptoms. When this occurs the remote tissue reactions seem to remain constant and are further damaged with recurring exacerbations of the focal process. If the systemic infection was followed by myalgia, infectious arthritis, endocarditis, or nephritis, it continues to do damage to the tissues originally involved. A joint may be involved as the result of local chemical circulatory or traumatic causes or, as Rosenow says, because of the selective action of a special strain of bacteria. If we consider for a moment the resulting pathology in a large joint it may help us to understand the changes in the organ of hearing which are accompanied by deafness. First, there are circulatory

changes followed by the pouring out of leukocytes from the blood stream and increased secretion. This is followed by the formation of new connective tissue, pressure symptoms, the absorption of cartilage, etc., depending on how far the process may go. The nerve supply shows at once functional disturbance of its sensory fibers by pain, and of the motor nerves by changes in its terminal filaments. We may cause the inflammatory products about the joint to disappear but restoration of function depends on the integrity of its special nerve supply. Now, in the organ of special sense we see somewhat similar phenomena. With a primary infection that was accompanied by deafness each recurring exacerbation adds to the damage of the tissues originally involved. That is, if the tissue reaction was in the mucous membrane, the fibrous tissue or bone, it continues as such and we have a progressive chronic catarrhal, catarrhal adhesive otitis media or possibly otosclerosis as long as the chronic focus is active or secondary foci continue the same type of infection. We have the same circulatory changes, the same pouring out of leukocytes from the blood stream and increased secretion with the formation of fibrous bands or the deposition of new bone. The analogy goes further, for we have at once functional disturbance of the end organ, that is, the acoustic centers and tinnitus. This occurs at once in every form of deafness. We may cause absorption of the inflammatory products in the tube or middle ear, but the restoration of hearing depends on whether the perception apparatus can be functionally restored.

For these reasons the writer has been forced to the conclusion that deafness is from the first concerned with the perception and that the conduction apparatus plays but a minor role. We have studied minutely the obvious gross tissue changes, but have lost sight of the fact that the perception apparatus is impaired from the first and continues to lose in function throughout the course of the disease. With the loss of tone perception there is tinnitus. Hearing tests show a loss in perception for the whispered voice and also a raising of the low limits. As the blocked tube becomes open

the low limits become normal, but if the progress is progressive the perception for the whispered voice diminishes. The low limits are not again raised until the function of the perception apparatus is markedly impaired. With the raising of the low limits we begin to have a negative Rinné, marked perception impairment of the upper limits, and, in some cases, involvement of the cochlear nerve. The impairment of the perception for the $2048C^{1}$ fork is often noticed and frequently tone gaps. In fulminating cases where in a short time the membrana propria malleus and incus are destroyed and yet the hearing remains good and may be nearly normal for years, the functional impairment of the hearing may be so pronounced that tone perception is wholly lost for the spoken voice. If this comes on suddenly as the result of the toxic action of a virulent infection that quickly clears up, the hearing returns because the perception apparatus is not permanently damaged. Metallic instruments are of no practical value in indicating the beginning of nerve deafness. When bone conduction is lowered for the $256C^{1}$ or $512C^{2}$ forks nerve deafness has been present for a long time. Deafness results from the action of a toxine on its special end organ in constitutional diseases and also in those chronic focal infections which so many patients have throughout life. The writer does not believe that alcohol and tobacco ever cause deafness with patients who have a normal throat. Both, however, cause a pharyngeal congestion and activate the focal process in the lymphoid tissue, increasing the absorption of the virus originally responsible for their impairment of tone perception. In the same way pyogenic foci in the teeth and sinuses are contributory causes of deafness because they drain into the lymphatics of the throat. Gross changes from hypertrophic processes in the conduction apparatus resulting in increased connective tissue, fibrous bands or bony ankylosis are of minor importance in deafness compared with the perception impairment which started with the original infection and had progressed with the more obvious tissue changes. Skilled otologists have difficulty in interpreting certain hearing tests because they try to analyze them to conform to cer-

tain types of deafness. Diminished tone perception is indicated in the same way at the beginning of all middle ear diseases, whatever the tissue reaction from a given infection. After perception impairment is far advanced in those cases involving the cochlear we make a diagnosis of nerve deafness. It is obvious that this must have been going on for a long time before nerve deafness can be detected by a metallic instrument. Tinnitus, which is the only way that the acoustic apparatus can react to stimulation or irritation, is present with the first impairment of tone perception. As we know, clinically these subjective sounds are intermittent at first, but with the progress of the disease they become continuous and change in character.

While the gross changes in the Eustachian tube and middle ear interfere with the transmission of sonorous vibrations these do not come within the range of ordinary conversation. Furthermore, the low limits clear up with the unblocking of the tube in acute conditions, even though perception for the whispered voice may be further lost. What is of more importance in the loss of tone perception resulting from a blocked tube is pressure on the stapes. While this seems to effect only sonorous vibrations and therefore is of secondary importance in the treatment of deafness, it undoubtedly is important in causing tinnitus. Now tinnitus is another term for labyrinthine stimulation or irritation, so that pressure and toxemia seem to be important factors in the gradual loss of tone perception.

We have, then, in every deep chronic infection of the lymphoid tissue which has been followed by deafness, two ways in which its progress is manifest. First, by gross tissue changes effecting the conduction apparatus but playing but a minor role in the loss of tone perception. Second, by the action of a toxine on the end organ impairing the function of the acoustic centers or, in a less number of cases, manifestly involving the cochlear nerve.

It would seem that the profound loss of tone perception in nerve deafness was due to changes in the terminal filaments of the auditory nerve rather than to changes in the

cortical centers themselves. Cases of advanced progressive deafness often show a bilateral hearing test that does not vary throughout the scale. This could be explained on the ground that it is probable that the auditory fibers from each ear end partly on the same side and partly or mainly on the opposite side of the cerebrum (Howell).

Treatment—While the writer has treated deafness on the above outline of its etiology for ten years, emphasizing the importance of infection, and failing to get results from inflation, except in recent cases the interpretation of the way in which deafness resulted has only been reached in the last few years. Obviously we remove the primary focus and all contributory foci tending to reinfect the lymphoid tissue. This makes it necessary to do radical surgery and not merely convert a chronic antrum into a latent one, or improve a pharyngitis without removing the cause above or below. Many latent antra with atrophic changes and without a pyogenic focus will still reinfect the lymphoid tissue and Eustachian tube. Gross changes in the nares have not been considered as affecting deafness unless infection was present. Submerged tonsils have been removed in adults in all ages up to seventy years whenever there was a change in the secretions of the pharynx or enlarged cervical glands under the angle of the jaw. Enlarged cervical glands following an acute infection that do not subside within a few weeks presuppose that the focal infection has not cleared up. Metabolic changes have not been considered as coming primarily from the intestinal tract but as having originated from the upper respiratory tract, as pointed out by Billings. With the removal of infection general measures are instituted to overcome the effects of a long continued toxic process. While the iodides, pilocarpin, strichnine, electricity auditory re-education, etc., are indicated, it is also necessary to improve the general condition. The loss of tone perception through depressed nerve states seem best treated on broad general lines. Many cases of deafness that have existed over a long term of years will improve markedly. In others the duration may be short and yet the treatment

is hopeless. At present there seems to be no way of determining how far the perception apparatus is damaged or, in cases of nerve involvement, whether degeneration is far advanced. Progressive or perception deafness has a most hopeful outlook if treated early and energetically when the cochlear nerve is not involved. All patients who have had a deep infection as a result of measles, scarlet fever, diphtheria, or flu, should have an interval tonsil and adenoid operation as a routine procedure without regard to age. Every patient who has a blocked tube and tinnitus accompanying a so-called acute infection should be carefully examined for a definite focus which should be treated surgically before secondary foci result. After this the follow-up treatment should be local and general. All cases of long standing focal infections are about 20% anemic and many have cardiac and renal conditions needing general medical care. The usual methods of treatment are all indicated under special conditions. In chronic progressive deafness, until the low limits are raised, however, the two important indications are the prevention of tubo-tympanic catarrh by the removal of chronic streptococcal foci and the recognition that impairment of tone perception is constantly going on.

INFECTED ADENOIDS.

Blocked Tubes—Pressure on Stapes.

CASE I.

S. S. 8 years. Dec. 27, 1919.

P. H. T and A operation 3 years ago. 2 months ago following measles commenced to be deaf. *Tinnitus* marked in both ears.

Exam. Epipharynx blocked by infected lymphoid tissue.

Sinuses. Ethmoids transilluminate poorly. Antra clear.

A. D. M. T. Ground glass appearance; indrawn. L. R. broken.

A. S. Same.

Hearing Test	R			L
	2/25		W. V.	2/25
	14	R	ac	16
	—	—	—	—
	6	256^{v}	bc	6
	—		Weber	—
	64		L. L.	64

Diag. Blocked tubes. Pressure on stapes.

Dec. 31, 1919. Adenoids removed under gas.

Oct. 28, 1920

R		L
25/25	W. V.	25/25
32	L. L.	64

P. S. Tonsilus persisted several months and gradually disappeared as the infection cleared up.

Treat. No inflation. Epipharynx treated after adenectomy until infection cleared up.

Key to Hearing Test:

W. V. Whispered Voice.

Cons. Conversation.

R. Rinne ac be

W. Weber.

U. L. Upper Limit (Galton Whistle).

L. L. Lower Limit (Dench Fork).

CASE II.

B. O. M. C. C.

I. B. 12½ years. May 24, 1919.

P. H. Measles, 9 years. Chicken pox, 9 years. Whooping cough, 7 years. Has been growing slightly deaf, especially following colds. Several attacks of tonsillitis. Throat does not feel right in the A. M.

Exam. B. cryptic tonsillar disease.

Septum. High deviation to left.

Turbinates. Posterior ends of inferior turbinates markedly enlarged, especially on the left side.

	R			L
	20/25		W. V.	25/25
Hearing Test	37	R	ac	45
	—	—	—	—
	8	256C	bc	10
			+ Weber	
	32		L. L.	32

July 1, 1919. Tonsilectomy. Ether.

R		W. V.	L
15/25		ac	20/25
20	R	—	19
—	—	bc	—
10	256C	+ Weber	9
32		L. L.	64

March 1, 1920 attack of mumps. Following this attack hearing less acute.

July 1, 1920. Went to New Hampshire camp for the summer.

Sept. 10, 1920. Epipharyngitis. Marked swelling of posterior ends of inferior turbinates.

Treat. No inflation. Treatment of infection. Sprays. Normal salt solution and 20 pc. argyrol.

R			L
15/25		W. V.	20/25
18	R	ac	18
—	—	—	—
8	256C	bc	8
		+ Weber	
32		L. L.	32

October 26, 1920.

R			L
23/25		W. V.	23/25
32		L. L.	32

November 16, 1920.

R			L
25/25		W. V.	25/25
32		L. L.	32

Note—Although this patient was out-of-doors all summer her ears did not clear up owing to a persistent epipharyngitis with blocking of the left posterior naris. As soon as the infection was removed the hearing returned to normal.

CASE III.

H. L. 51 years. Jan. 11, 1916. Single. American.

P. H. Measles, chicken pox, scarlet fever (mild). History of abscesses in childhood. Last 3 or 4 years history of swelling in one ear and then the other. No loss of hearing patient thinks. Head colds frequent. Occipital headaches with tenderness of the scalp at times Rheumatism since April in knees and fingers. Is being treated for rheumatic iritis. Tinnitus continues since August in both ears. General health always poor. History of abscess in intestine and of mucous colitis.

Exam. Septum to left with a large posterior basal spur.

Turbinates. Hypertrophic changes. Do not shrink under cocaine.

Sinuses. Negative.

Teeth. Negative.

Tonsils. R. shows cheesy debris.

Hearing Test R			L
6/25		W. V.	12/25
19	R	ac	19
—	—	—	—
8	256C	bc	8

		+ Weber	
32		L. L.	32
N		U. L.	N

Treat. Tonsillectomy. Submucous resection.
Treatment of infection.
Teeth looked after.
April 5, 1917. Gall bladder operation.
Dec. 29, 1919. Otalgia dentalis.
March 28, 1921. No rheumatism or iritis since tonsillectomy.

R			L
25/25		W. V.	25/25
	R	ac	
		—	
		bc	
—		Weber	—
32		L. L.	32

Note: See history. Infection in teeth and throat followed by head ache. Rheumatism, rheumatic iritis, infection of gall bladder. Deaf ness, cured by removing the chronic foci without inflation.

L. ANTRUM—DEAFNESS.

CASE IV.

E. G. 8 years. Nov. 16, 1920. Only child. M. and F. living.

P. H. Measles at 3 years with aural discharge. T. and A. operation one year ago. Oct. 8, second T. and A. operation. Deafness worse than before. No discharge, but ear feels sore to touch. Otalgia 3 days ago. Head cold. Pus in left naris. *X*-ray shows left antrum. Wasser mann negative.

A. D. Drum dull and retracted with thickening and healed perfora tion, anteriorly and below. Ear dry.

A. S. Same as A. D. except for more retraction.

Dec. 2, 1920. Left radical antrum operation.

Hearing Test	R			L
	2/25		W. V.	2/25
	20	R	ac	30
	—	—	—	—
	28	256C¹	bc	24
			Weber +	
	64		L. L.	32

May 27, 1921. Light reflex in right ear slightly broken.
Drum retracted. Old scar anteriorly. Left ear-drum retracted. Fair ly good light reflex. Slight thickening.

May 20, 1921	R			L
	3/25		W. V.	20/25
	17	R	ac	30
	—	—	—	—
	28	256C[1]	bc	24
			Weber	+
	N		U. L.	N
	64		L. L.	32

Note: No inflation. Infection cleared up and best ear improved from two to twenty feet for whispered voice.

CASE V.

R. Eff. O. M. S. L. O. M. S. Ch. Cum. Grans.

J. C. 25 years. Barber. Married. May 25, 1921.

P. H. History of discharge from left ear as a child, then for short and infrequent periods until two years ago. While at Camp Devens in 1919 had double pneumonia and the discharge has been at shorter intervals. No pain, no vertigo, or headaches. Colds frequent. Chronic catarrh. History of diseases of childhood uncertain.

Exam. B. Cryptic tonsillar disease. Large central adenoid. Transillumination not so clear on the left side. *M. M.* of nares injected Large gland under angle of left jaw.

Aural Exam. R. Ear. Healed horseshoe perforation involving greater part of membrana propria. Short process visible. Long process foreshortened and apparently tied down to the promontory. Large calcarious deposits in the scar tissue anterior to the long process over the region of the tube and in the posterior superior quadrant. Malleus does not move under otoscope.

L. Ear. Posterior superior half of drum greyish in color and thickened. Short process indistinct. Anterior and inferior half of drum filled with pale granulation tissue. Discharge moderate. Almost entire anterior half of drum replaced by granulation tissue.

Hearing Test	R			L
	25/25		W. V.	25/25
	16	R	ac	16
	—	—	—	—
	8	256C[1]	bc	9
	—		Weber	—
	N		U. L.	N
	32		L. L.	32

Note: Here was a history dating back to childhood of intermittent discharge, in which the conduction apparatus was seriously involved and yet there is normal hearing.

Conclusions.

1. Every case of loss of tone perception seems to result from the action of the toxine of a chronic pyogenic focus on the end organ.

2. The toxine is probably due to a special strain of bacteria with a selective action on the organ of hearing.

3. The gross tissue changes seem analogous to those taking place in other organs, as the result of a focal infection, the return of function in each case depending on the integrity of its special nerve mechanism—either the acoustic centers or cochlear nerve.

4. Diminished tone perception seems to start with the onset of the deafness and is more important than the changes in the conduction apparatus. The early raising of the low limits due to the blocked tube clears up as the tube opens. Following this the tube is more open on the side of the deaf ear as atrophy succeeds the hypertrophic salpingitis.

5. When the 256^{C} or 512^{C} fork shows lowered bone conduction nerve deafness is already far advanced.

6. The end result in chronic progressive deafness is marked perception impairment or nerve degeneration.

7. No hearing test is characteristic of any particular form of middle ear disease.

8. Gross tissue changes in the middle ear follow the original type of infection and do not change.

9. Alcohol and tobacco seem to cause eighth nerve deafness by causing a pharyngeal congestion with increased absorption of the toxine from the chronic focus.

10. Patients treated early have every right to expect recovery if the primary focus is removed and the deafness is confined to a functional disturbance of the acoustic centres.

Discussion.

Dr. Norval H. Pierce, Chicago, said this was such an extraordinary paper and so at variance with knowledge on otology that it should not go unchallenged. The conclusions

were not based on laboratory methods and were purely hypothetical. Otosclerosis was wiped away in a paragraph or two, although our knowledge of it has been painfully and laboriously built up by many men, during many years. It was also against otological belief that loss of lower tone limit was evidence of perception deafness. No remark was made of high tones, the Rinné and bone conduction, so that the observations did not coincide with those of others. Internal ear disease might combine acute otitis media with serous labyrinthitis, and in due time there would be permanent tinnitis and impairment of sound perception apparatus, but this was rare and dependent on the length of time the disturbance persisted. To make sweeping assertions that all disease of the perception apparatus were due from their inception to disease of the conducting apparatus was to create a generalization which did not recognize the work of other men.

Dr. Charles W. Richardson, Washington, D. C., said that he had read with interest other papers by the speaker, but he felt that this one was particularly dogmatic. It only presented the author's deductions, not facts. The conclusions were not borne out by evidence presented and one should therefore be careful in accepting them. No doubt certain cases suffered perception impairment as a result of toxic influences, but these did not predominate, and to leave out the question of the conducting apparatus was going too far. If one went on the hypothesis that infection of the perceptive apparatus, as the writer states, was the sole cause, nothing would be done for cases due to other causes. He had seen two children from Boston who seemed likely to suffer this misfortune. Dr. Richardson felt sure that toxic influence on the hearing apparatus also might arise from the gastro-intestinal, as well as from the pharyngeal tract. Another point was that in intense infections of the sinus of long duration there was seldom disturbance of the perceptive apparatus. The antrum and ethmoid should have as much effect as the tonsil.

Dr. Max A. Goldstein, St. Louis, said that he had hardly recovered from the shock of hearing Dr. Emerson say that all deafness came from deep infection. This overthrew all accepted pathological deductions and the entire anatomy and pathology would have to be reconstructed. Was there any use, then, in the tests with the tuning fork, and did Dr. Emerson make those tests? Could boiler maker's deafness or shell concussion be produced without infectious preliminary? The experiments on mice with the electric percussion hammer had seemed beautifully logical in their results at the time of their presentation. The theory of relativity, with its overthrow of some of the principles of gravity, had been founded on far more logical reasoning than Dr. Emerson had presented.

Dr. L. W. Dean, Iowa City, said that in regard to involvement of the nerve and end organ in lesions of the middle ear that Mr. Bunch and he had investigated the tonal range on a number of cases of middle ear disease. In only two cases was no effect found in the tonal range above 2000 d. v. In these cases there was clinically no evidence of nerve or end organ lesions. One of the cases mentioned above was that of acute catarrhal deafness; after inflation the hearing was immediately normal and the measurements of the tonal range indicated no defect within the normal tonal range. These findings indicated to Dr. Dean the presence of a pure middle ear lesion. In regard to tinnitus: Filling the external auditory canal with boric acid powder will cause a distressing tinnitis, this can not cause irritation of the nerve or end organ.

Dr. J. Gordon Wilson, Chicago, said that Dr. Emerson's paper was bristling with very radical statements. All are agreed that toxic agents reaching the nerve and its endings play an important part in affections of the nerve mechanism; but he fails to find in Dr. Emerson's paper sufficient proof that such is also the case in the conducting mechanism. That it may be so, is possible when we consider how other joints may become infected. As regards the source of infec-

tion while our knowledge of a possible source in the pharynx and nose is certain, there is accumulating evidence that the gastro-intestinal tract may play no inconsiderable part.

Dr. George L. Tobey, Boston, said that Dr. Emerson might have been too dogmatic in statements which might later be modified. This paper and others had presented the fact that infection did play an important role in deafness, a theory not generally accepted by otologists. Although the nomenclature was too dogmatic, Dr. Emerson had accomplished what he set out to do, that was emphasize the role of infection. One man of 55 had tinnitis for six months and was completely cured by removal of an abscessed tooth. This discussion had been very well worth while.

Dr. Frederick L. Jack, Boston, said that nobody at present knew the etiology of otosclerosis. It might be due to an infection—as suggested by Dr. Emerson—in some or all cases. Work on stapedectomy a long time ago, however, leads me to believe that all cases are not due to infection. In a few cases remarkable improvement in hearing had followed removal of the stapes. The more firmly the foot plate of the stapes is fixed, the more impairment in hearing. The inference was that the perceptive organ was secondarily affected from disuse by pressure due to disease of the sound conducting apparatus. It is an old tradition—to say the least—that the sound conducting apparatus of the middle ear plays an important role in deafness. Dr. Emerson's paper, however, gives us food for thought.

Dr. S. F. Snow, Syracuse, N. Y., said that his deductions were that 90 per cent of extremely severe cases of deafness came from a toxemia or some focal infection. Most toxemias arise from the gastro-intestinal tract, but sometimes they come from the tonsils and teeth. Emphasis should be placed on intestinal toxemias in chronic cases.

Dr. B. Alexander Randall, Philadelphia, said that Dr. Emerson's paper had made him somewhat dizzy, but he thought that 50 per cent. of tinnitus was due to stenosis of the Eustachian tube. In his own case he had tinnitus for 40 years, but perfect hearing. Toxemia was no doubt an important factor, but could not be regarded as the chief and underlying one, as Dr. Emerson had said.

Dr. Harris P. Mosher, Boston, said that the more he had to do with cases of progressive deafness, the more he was convinced that nerve involvement from infection played a greater part than impairment of the sound conducting mechanism. The impairment of the sound conducting mechanism, like the nerve deafness is due to infection. The nerve deafness, however, comes earlier than is usually supposed, and often soon outstrips the conduction deafness. A low grade continuing infection from some part of the nose or throat, the speaker felt, was the chief cause for this chronic progressive deafness.

Dr. Wells P. Eagleton, Newark, said that his views upon the subject of deafness had undergone great changes since reading Dr. Emerson's first paper and while he was not prepared to go so far as Dr. Emerson did, he felt that he had been able to do more for his patients for having studied Dr. Emerson's work.

Dr. F. P. Emerson, closing, said that he was sorry for the shock that his views seemed to have caused to so many of the members. The Society should consider these questions with an open mind, and if any of the members had a better hypothesis to present he was willing to reconsider his conclusions. If the subject had been too dogmatically stated it had been in the endeavor to cover a large subject superficially. Many of the men were brought up purely as otologists, and the subject of the nasopharynx was a later development. The two studies gave different viewpoints. None of the men were particularly happy in the treatment

of chronic catarrhal deafness. The views presented were an honest, sincere expression of what the speaker conceived to be the case. He might be wrong. Treatment of infection had been with him the means of stopping the progress of chronic catarrhal deafness. The Eustachian tube had always been more open on the deaf side. That implied definite pathology. In cases of joint pathology there was gross tissue destruction and interference with the nerve supply, and removal of the inflammatory infiltration did not restore the joint entirely. The same might be true of the ear. In regard to tinnitus, this might be a reflex from the eye or from intestinal toxemia, but the kind that occurred with beginning deafness was no doubt due to pressure on the stapes on account of the blocked tube. Tinnitus was a protean manifestation. Complete hearing tests were made by the speaker. In regard to infection, men were still learning. One would not have said five years ago that a submerged tonsil would cause neuritis, endocarditis, arthritis, yet it had been proved capable of doing that. The question of clearing up focal infection became more and more pressing, and the speaker said he sent every case to the oral specialist capable of interpreting infection of the bone. Teeth and sinus infections were only contributing factors because they drained into the throat. Concussion deafness was accepted by everybody and was a common observation. The speaker said that he was willing that this paper be omitted from the records of the Society if deemed proper, but it had been presented as the result of ten to fifteen years work along this line, which had caused him gradually to reach the conclusions stated. One of their best men had said to him that this work would ultimately be proven right. If a better etiological factor could be proven, he would be glad to apologize.

WHAT SHOULD WE UNDERSTAND BY LABYRINTHINE TONUS?

By J. GORDON WILSON, M. D., Chicago.

It is generally recognized that afferent nerve impulses coming from the labyrinth act reflexly on certain muscles of the body to keep these muscles in a continuous state of tension. Ewald noted that after unilateral labyrinthine destruction, there was a lack of precision and a diminution of strength in certain striated muscles and formulated his hypothesis of labyrinthine tonus. It is also recognized that nerve impulses modifying this state of tension may come from other peripheral sources as well as from certain areas in the central nervous system. Muscle tonus is a subject of great complexity and still of much obscurity, though recent work has helped to a better understanding. It seems therefore that time may well be given to a brief consideration of some of the more recent experimental work bearing on this subject and the deductions from such work. A knowledge of what tonus implies is of fundamental importance to an understanding of the physiology of the labyrinth. On such an understanding must be based the interpretation of many of the disturbances observed in pathological lesions involving the vestibular nerve endings and its central pathway and the just appreciation of the value of many of the tests we employ in normal and defective labyrinthine conditions. Two questions at once present themselves:—

I. What is muscle tonus?

II. What relation has the labyrinth to muscle tonus?

What Is Muscle Tonus?

Tonus is the slight persistent tension which is characteristic of healthy muscle and its loss or diminution is shown by an alteration in the normal attitude or gait or muscle power of the animal. It is present in unaltered

amount in various lengths of the muscle, and so a muscle may carry the same weight with different lengths.

A basic conception of muscle tonus appears to me to be best obtained by observing the action of certain muscles in invertebrates. In many of these certain muscles are differentiated to give movement, while others are differentiated to secure a persistent tension or fixation. An example of this differentiation is seen in the adductor muscles of molluscs. In molluscs an elastic ligament opens the shell, an adductor muscle closes it. It is common knowledge how difficult it is to open the shell of a bivalve, such as, for instance, the oyster shell. There is sufficient evidence to show that this is not due to the action of a powerful muscle. The following account of v. Uexkull's work from Bayliss (Bayliss, Principles of General Physiology, London, 1915, p. 534) gives one a clear conception of this action and an interpretation of it: "If one takes a normal Pecten out of the water, it gives two or three flaps with its shells before permanently closing them. If, while it is open, a piece of wood is pushed between the shells, these close and hit upon the wood with so powerful a crash that their edges are splintered. The wood is then held as in a vice. One can, however, pull it out by twisting it about backwards and forwards, and then one is surprised to see that the shell remains motionless, just as would the jaws of a vise if an object clamped between them had been forced out. The shell movement shows not the least degree of elasticity. The muscular fibres seem to have been suddenly frozen solid. If one next tries to open the shell, no effect can be produced, but even the pressure of a finger is sufficient to press them nearer together, and in this position they remain fixed again, so that they cannot be brought back. The nearest mechanical illustration that can be given is that of two racks with saw teeth, these will glide over one another if pulled in the direction of the arrow (see diagram, Bayliss, p. 534), but resist any pull in the opposite direction. The fact that the animal itself can allow the shells

to open, shows that the 'catch' can be removed by some means." Two points of importance must here be noted: (1) if weights be applied to the shell in any degree of this contracture, no increased metabolism and no fatigue can be demonstrated even after days. (2) the muscle of the shell can hold up a weight it cannot raise. In Pecten the adductor muscle can be shown to consist of two parts, called by von Uexkull the motor muscle and the catch muscle, each with separate nerves. If the catch muscle be cut the motor muscle when excited can close the shell, which remains closed so long as the stimulation lasts, then the elastic ligament pulls it open. "If the catch muscle be cut through while the shell is closed the other muscle is unable to keep it closed; whereas if the motor muscle be cut the shell remains closed." (Bayliss, loc. cit. p. 536).

In Echinus, the sea urchin, a similar differentiation of muscle can be seen. The Echinus creeps forward by the pull of its tube feet, assisted by the action of spines set in ball and socket joints. Each spine is provided with two muscles, one which moves the spine, the other which fixes the spine in the position to which it has been brought by the muscle of movement. In each pull forward the spine is so placed as to prop the weight of the body, and is fixed in a position of advantage to aid further progression. (Sherrington, Postural Activity of Muscle and Nerve. Brain, vol. 38, 1915, p. 203).

In vertebrates no such differentiation of muscles of movement and muscles of fixation can be demonstrated. But a moment's thought will show that there is differentiation or duality of function. As in particular groups of invertebrate muscles, so in groups of vertebrate muscles, it is certain one can distinguish two separate functions (1) movement, and (2) fixation to give a definite and prolonged pose. Certain muscles incline more to one phase than to the other. For instance, certain muscles, *e. g.* sphincters appear to be more tension or postural muscles, muscles whose prime function seems to be more to secure a certain permanent fixation of form and pressure than to produce movement. Further in

vertebrates the skeletal muscles are capable of both postural fixation and of motion. Thus in a definite action one group may show fixation of attitude or posture while another shows movement and definite action, *e. g.*, an animal scratching an irritant off his neck. While the evidence in favor of duality of muscle function in vertebrates appears satisfactorily demonstrated, the evidence in favor of a duality of nerve source for these functions, somatic and sympathetic, does not appear to me to be established and will be referred to later.

Experimental evidence placing tonus of muscle on a scientific basis dates back to the article of Brondgeest in 1860. (Über den Tonus der Will-kührlichen, Muskeln. Arch. für die Holland Beitrage für Natur u, Heilkunde, Utretch, 1860, Bd. 11, p. 329). Brondgeest showed that the most important source of tonicity for muscles of the limbs are afferent impulses originating in the limb itself. Sherrington added largely to our knowledge of tonicity by his study of muscle tonus in decerebrated mammals. In decerebrated animals (section of the brain in front of the corpora quadrigemina) while respiration and pulse are unaffected certain groups of muscles become rigid—a persistent tonic spasm—the elbows and knees are extended and the head and neck are retracted. The muscles chiefly affected are the extensors of the elbow, knee, shoulder and ankle, and the retractors of the head. The hand and foot are little affected and the fingers and toes not at all. (Sherrington, Schafer's Physiology, vol. 2, p. 914, and Luciani's Physiology, vol. 3, p. 518). The decerebration has removed motor control probably from the spinal motor centres and so the constant tonic reflexes coming chiefly from peripheral sources are allowed full action on the motor centres and the muscles are seen in a state of uncontrolled tonic activity. Sherrington showed that in skeletal muscles the muscle tension we are here concerned with is not uniformly distributed but is confined to muscles whose function it is to support the body in its normal attitude. Thus we find these reflex stimuli to maintain muscle tension distributed to the muscles which keep the vertebral column erect (e. g.,

as in standing), which hold up the head (e. g., neck muscles), which close the jaw, to the extensors of the limbs which support the body, to the muscles which bend the back (opisthotonos). In short this tonus is confined to muscles which maintain the erect posture of the animal, which counteract gravity, which prevent the animal sinking to the ground, which maintain it in the upright posture. The muscles which act in the opposite direction do not possess it. Sherrington called this postural tonus. The following (Sherrington, Postural activity. Brain, v. 38, 1915, p. 198) illustrates how postural tonus becomes active in a change of attitude of an animal.

"If the head of the reflexly standing decerebrate preparation be forcibly flexed, the postural contraction of the extensor muscles of the fore limbs is inhibited, and the animal's forequarters sink, while at the same time the postural contraction of the extensors of the hind limbs increases, raising the hind quarters. The preparation thus assumes the attitude of a cat looking under a shelf. On the contrary, if the head of the preparation is passively tilted up and back the postural contraction of the extensor muscles of the fore limbs increases, raising the forequarters, and at the same time the postural contraction of the extensors of the hind limbs is diminished so that the hind quarters sink. The preparation thus assumes the posture of a cat looking up to a shelf. There goes therefore with each main posture of the head even passively imposed upon the decerebrated preparation a corresponding reflex modification of the reflex posture of the limbs."

It is on these muscles that the labyrinth acts. It is obvious that man standing erect has an attitude different from that which gravity would give were certain muscles (antigravity muscles) not acting. Further he is constantly placing his body in attitudes or postures which call for modifications of the erect position. To maintain the body in such altered postures there must be a readjustment of certain muscle groups, some becoming longer, some shorter. In each new position the tension of the muscle as shown by its capac-

ity to bear weight is unaltered. The tension tested by the hardness of the muscle, estimated by the degree of denting to various weights placed in its fleshy part, is practically the same in all postural lengths. In short, certain skeletal muscles can adjust themselves to different lengths and at each different length can counteract the same weight. This tension remains unaltered over a long range of length of muscle. But the tension which the muscle can maintain in this postural attitude is less than the maximum tension which it can exert in executing movement. The two differ in so far that while the former can not be fatigued, the latter, voluntary tension, can be fatigued.

Tonus is essentially an altered state of the muscle itself. But how in the muscle such definite tension for an indefinite period, apparently without fatigue or increased metabolism, is brought about we can at present only surmise. In the case of muscles of invertebrates Bayliss believes it to be something which roughly may be said to correspond to a catch or ratchet mechanism. That in lengthening or shortening to counteract gravity the skeletal muscles of vertebrates pass into a state which speaking generally may be likened to "catch" cannot be doubted. But what this state is we do not know. It has been suggested that under nerve influences the muscle fibre is capable of altering its fluidity and that when fixed it is in the state of gel.

Though we do not know what the essential change in the muscle may be, we do know that this state and change of state can be produced reflexly by nerve stimuli. "Postural tonus is the expression of a neural discharge concerned with the maintenance of attitude." (Sherrington, Integrative action of the nervous system; New York, 1906, p. 340). In vertebrates the nerve reflex on which this persistent tonus depends chiefly comes from the anti-gravity muscles themselves, for section of the posterior roots of the nerves from these muscles immediately destroys the tonus. The stimulus from the muscle and its tendon comes through the afferent spinal nerves and the dorsal spinal root. This is easily seen in the frog in which the afferent spinal nerves of one leg are

cut. If the frog be then held vertical the limb corresponding to the sectioned nerves is held less flexed than the other, an attitude which can be shown to be due to diminished tone in the muscle of that limb. But the tonus can be modified by reflex stimuli from other sources—one important source is the otic labyrinth.

In non-decerebrated animals the labyrinthine influence in muscle tension was shown in Ewald's experiment on the beak of a pigeon. After splitting the lower bill of a pigeon into two equal parts and destroying the labyrinth on one side, Ewald (Ewald, Physiol. Untersuchungen über das Endorgan des Nervus Octavus, Wiesbaden, 1892, p. 181) found that though the closure of the bill was usually well executed the maintenance of that closure was not so well performed on the side of the labyrinthine lesion, nor could that side maintain so well a pull on it of a weight. He also found that there was in the pigeon a similar weakness in the limb of the operated side to maintain a load.

As a result of experimental work published in 1912 (Wilson and Pike, The Effects of Stimulation and Extirpation of the Labyrinth of the Ear and Their Relation to the Motor System, Philosophical Transactions, Royal Society of London, 1912, vol. 203, pp. 127-160) and of work communicated to this Society two years later (Wilson and Pike, The Relation of the Labyrinth to the Cerebellum and the Cerebrum, Transactions of the American Otological Society, 1914), it was shown that destruction of the labyrinth in dogs produced a permanent change of attitude, especially of the head. If one labyrinth be removed, there is a permanent torsion of the head to the injured side, the occiput turned down and rotated forward, and there is a leaning, particularly of the anterior part of the body, to this side. This we believed was due to over-activity of the other labyrinth (increased tension). If both labyrinths have been removed at one time, there is no such torsion of the head or inclination of the body to one side. Further it was shown that the attitude of the head produced by unilateral destruction could be restored to normal by destruction of the other labyrinth. It

was also shown that such torsion did not follow complete removal of the cerebellum, but did occur when the labyrinth was destroyed subsequent to cerebellar removal, both of which set of experiments showed that the pathway from the labyrinth to the neck muscles did not pass through the cerebellum. We further showed that so far as the influence of the labyrinth on the tension of the eye muscles was concerned the cerebellum played no part, for removal of the cerebellum did not alter the result. Dr. Pike later showed that the altered attitude could be restored to normal by section of the posterior roots of the cervical nerves on the opposite side. Briefly, then, the torsion of the head in the dog or cat persists after unilateral labyrinthine destruction but can be reduced or abolished if at a later period: (a) the other labyrinth be destroyed, (b) the afferent nerves of the neck muscles on the opposite side be cut. If the labyrinth be removed and the dorsal cervical roots cut on the same side, the torsion following the first is accentuated by the second.

This torsion of the head is much more marked in animals than in man. In the latter the torsion is negligible, control from the higher centres and compensation being much more effective. It is interesting here to note that it has been demonstrated that tonic impulses from a perepheral source can be reenforced. De Kleijn has shown that in rabbits though the tonic reflexes from the neck muscles are normally very feeble compared with those from the labyrinth, yet after bilateral labyrinthine removal these tonic neck reflexes are very distinct and very energetic.

Our knowledge of tonus and not least of labyrinthine tonus has been greatly advanced by a series of investigations carried on at the University of Utrecht by Magnus, de Kleijn and their co-workers. As has been said above in decerebrated animals the removal of motor control allows the free action of the peripheral reflex sources of tonus to be observed in decerebrated animals. Magnus and deKleijn (Magnus and de Kleijn, die Abhängigkeil des Tonus der Extremitates—muskeln von der Kopfstellung, Arch f. d. ges. Physical, 1912. Bd. 145, p. 456) showed that in the decerebrated animal

the extensor tonus of the limbs can be modified by different attitudes of the head in space. They showed the relative values of the reflex sources in the labyrinth and neck muscles from which these modifications come. They were able to study these two factors separately (1) eliminating the labyrinth by destruction and (2) getting rid of the neck reflexes by incasing the animal in a plaster cast. With the labyrinth destroyed the animal showed good extensor rigidity and tendon reflexes and there was no alteration in this rigidity when the body as a whole underwent a change in space, though a change did occur so soon as a movement of the head on the neck occurred. With the animal encased in plaster eliminating the neck reflexes, the extensor rigidity was modified by a change in space of the animal as a whole, always excepting rotation in a horizontal plane, that is, relative to gravity. This alteration of the head in space shortened or lengthened the limbs and the attitude so assumed was maintained (postural tonus) so long as the head was held in this particular posture. In different positions of the animal the same head movement may have different and even opposite effects according to which of these factors, labyrinth or neck reflex, was predominant.

In the head segment there are two important sources of this tonic reflex action, the labyrinth and the neck muscles. These have to be taken into account in all postural reflex movements of the body when the head is displaced. The labyrinth is an organ which reacts to gravitational force and is concerned with the adjustment of the head, of the eyes and of the jaw to the vertical. With the adjustment of the head segment must necessarily come an adjustment of the vertebral column and limbs. The neck muscle reflexes have to do with the movements of the head relative to the body.

To the otologist there is one group of muscles in which compensatory movements following altered position of the head in space and the persistent tension which remains unaltered as long as the head remains in this position (postural tonus) are of great interest, namely, in the extrinsic muscles

of the eyes. To this special example of corrective reflexes I would refer for a minute.

The physiological basis of single vision with two eyes depends on the object falling on identical or corresponding points of the retina. If one retina be placed in front of the other with the fovea in contact and the temporal half of the one retina covering the nasal half of the other, any point of one will cover a corresponding point of the other. (Schäfer, Physiology, Edinburgh, 1920, vol. 2, p. 1124). In the head the eyeballs though freely movable naturally tend to assume a position—primary position of the eyes—in which in man the lines of sight are parallel and the plane of sight horizontal. This attitude is seen in deep narcosis and also after death before rigor mortis. In this primary position of the eyes the tension in the various eye muscles are in equilibrium and this balance is brought about as is balance elsewhere by the co-ordination of reflexes from the retina, from the labyrinth, and the kinasthetic impulses from muscles of the eye and neck.

The functional activity of the eyes depends on its constant relation to the horizontal. No matter how the head shifts this adjustment to the horizontal must be ensured and must be retained so long as the attitude of the head is in this posture. The existence of this adjustment and the maintenance of gaze within wide limits is an every day experience and is a necessity to normal existence. When we alter and assume any head position the eyes automatically modify the position of the visual field. I beg you to note that I am not here concerned with the question of "sensing the vertical."

As has been shown the attitude of the head through tonic reflexes from the labyrinth and from the neck muscles acts to establish and maintain the attitude of the animal to the vertical. In the maintenance of the attitude of the eyes to the vertical or horizontal the labyrinth and the neck musculature act decisively on the freely movable eyeballs.

Van der Hoeve and de Kleijn (van der Hoeve and de Kleijn, Tonische labyrinthreflexe auf die Augen, Arch. f. d. ges. Physiol., 1917. Bd 169 p. 241) studied the tonic labyrinth

reflexes in the eyes of rabbits and found that each position of the head in space gives a particular "roll" of the eyes, rotatory or vertical or a combination of these, and that each position of the head in space necessitates a definite position of the eyes and this modified position persists as long as the head is kept in the modified position. One labyrinth influences the eyeball rotations of both eyes but chiefly the muscles of the opposite side. After the labyrinths on both sides have been extirpated all such tonic reflexes on the eyes from modification of the head in space cease. No law of sideways movement of the eyes in the various positions of space could be shown. In a later paper de Kleijn published his results in regard to tonic neck reflexes (after removal of the labyrinths). He found that to each position of the head in relation to the trunk corresponds a definite position of the eyes in the orbit. These neck reflexes are weaker than the labyrinth reflexes. But he belives that in the rabbit tonic action in the eyes moving in the horizontal plane are chiefly influenced from the neck reflexes.

It appears, therefore, that the eyes in a particular movement of the head tend to preserve their relation to the horizontal, that is, the relation of the retina to the horizontal. Thus in movement of the head upwards the eyes roll down and within limits the fixation will persist; the fixation being determined by the desire or ability to focus a particular object. Here the labyrinths act in keeping with the general action of proprioceptors to adjust and maintain the posture of the eyes in varying movements of the body. But if the head be turned further so that the fixed object gradually fades away from sight two things occur, diminution of retinal stimulation and increased tension of the eye muscles, and the eye returns to its primary position with a quick movement. This paper is not concerned with the question of nystagmus which would necessitate a more detailed consideration of the results of the labyrinthine reflexes of movement (kinetic or dynamic) seen for example in rotation. We are here concerned with the tonus (persistent or static)

effect, which appears to me the primary and elementary factor, in labyrinthine activity.

When one labyrinth is destroyed this ability to posture efficiently the eye is affected for a time — the duration varying with the position of the animal in the vertebrate phylum. Equilibrium is disturbed and a deviation occurs which is the primary factor in nystagmus. But the normal association of binocular movement is maintained. This deviation is caused by tonic reflexes from the intact labyrinth and remains until compensation occurs. It therefore takes some time for the eyes to regain and retain the normal posture—a posture which has lost one of the factors essential to its maintenance. Even after the nystagmus has disappeared and the deviation corrected, I have seen the recurrence of the deviation and of the nystagmus by placing the animal in a position unusual to it, e. g. on its back. Later however this also is corrected.

The Measurement of Tonus.

Attempts to estimate the degree of tonus present in a muscle have proved exceedingly unsatisfactory. The steadiness and persistence of the contraction present in normal tonus in the various degrees of contraction of a muscle renders its estimation difficult. I know of no method by which an accurate estimate can be made. If tonus means the postural fixation which a muscle assumes in various attitudes of the animal it is open to doubt whether we can measure tonus. Attempts have been made to measure the degree of muscle tonus in different lengths of a muscle by the degree of weight impression (Eindruckbarkeit) on the muscle. It has been found that this weight impression was nearly equal for varying lengths in varying postures. (Sherrington, Postural Activity of Muscle and Nerve, Brain. 1915, vol. 38, p. 201).

However, inasmuch as the tonus is so markedly due to and affected by nerve influences acting reflexly from various sources one may measure variations of tonus effects relative to a normal. Thus a hypertonus may occur from removal of motor control which allows tonus impulses to play unimpeded

on the muscles. Such occurs experimentally in the decerebrated rigidity of animals and in man is seen when there is a lesion sufficiently gross to interfere with cortical control (spasticity). A hypotonus may occur from removal of a source of tonus stimulation, e. g. the destruction of the labyrinth. In man loss of tonus from labyrinthine destruction rapidly passes—the falling, the staggering, the nystagmus, etc. These effects as one would expect are more marked in the head segment. On the trunk and limb I would regard this tonus loss as a mass effect, secondary to the head. The knee jerk is related to the tone of the skeletal muscles and an indispensible condition for the appearance of a knee jerk is tonus in the muscle. Yet I am not aware that there is any evidence of alteration of knee jerk after loss of a labyrinth. In hypotonus there is recognized an abnormal extensibility of muscles and joints which abnormal relaxation is due undoubtedly to dimished tension in muscles and can be compared to increased movements of joints after death. The measurement of the hypotonus may be made by the excursional capacity of movements of the joints; thus fingers may be bent back to an abnormal degree though individual movement is good. But such increased movements of joints has not been seen in labyrinthine affections, probably because the joints are primarily influenced by the proprioceptors, regulating the segment to which they belong, whereas the labyrinth is primarily concerned with the head segment. The impossibility of estimating variation of labyrinthine tonus by the pressure exerted on a dynamometer will be obvious from what has been said. In regard to this it is well to recall that the maximum tension in executing a movement is greater than the tension required for posture.

The Relation of Postural Tonus to the Nervous System.

Tonus has been demonstrated to be distinctly under nerve influences, chief of which arise in the muscles themselves. Lesions of the posterior roots containing the afferent nerves arising in the muscles of an extremity greatly lowers or abolishes the tonus of that limb. In decerebrate rigidity section

of the posterior roots of a limb abolishes the rigidity in the limb muscles. In neither case does destruction of the labyrinth abolish the rigidity of the limbs though it can be shown to lower the tonus.

The non-controlled tonic effect seen in decerebrated animals is destroyed not only by section of posterior roots but is destroyed by section of spinal cord (ventrolateral columns) and by section through the medulla. So the impulses coming in from the posterior roots do not immediately cross to the spinal motor nuclei but pass up the cord to a centre in the mid brain and pons. The reflexes from all muscle sources come together in the pons and mesencephalon—since Sherrington showed in decerebrate animals that removal of the cerebellum has seldom any effect in postural tonus. Tonic impulses from the labyrinth also pass into this area for it was shown by Dr. Pike and myself that the pathway from the labyrinth to the neck muscles and to the eye muscles do not pass through the cerebellum and that section of brain anterior to the eye nuclei in pons and mesencephalon do not interfere with eye deviation following labyrinthine stimulation or unilateral destruction. De Kleijn and Magnus (Independence of the labyrinthine reflex on the cerebellum and on the position of centres for labyrinthine reflexes in the brain stem) Pflüger's Archiv., Bd. 178, 1920, p. 163) identified three centres in the brain stem concerned respectively with head and trunk movements, compensatory eye movements and positional reflexes. It will be interesting to know the relation of these to the nucleus motorius tegmenti, the primitive co-ordinating centres extending throughout the brain stem and including the red nucleus and Deiters. (Herrick, Introduction to Neurology, 1915, p. 181).

We may therefore say that there is a tonic centre in the mesencephalon, pons and medulla activated by impulses from the tonic centres in the muscles and in the labyrinth. This tonic centre in the mid brain is activated as far as the limbs are concerned primarily from the proprioceptors in the limbs and secondarily from the labyrinth, so far as head is concerned from the muscles of the cervical region and of the

labyrinth. In the case of the eyes, to these latter have to be added the eye muscles and retina. In the head region the labyrinth plays a more important role than in the limb segments. To this tonic centre come the tonus impulses from all tonus receptors. From it there issue forth corrective effector responses. The work of this centre is automatic, but higher cortical centres can recognize its results and control its activities. The cerebellum also probably plays a part in adjusting and co-ordinating.

In man and the higher mammals though the labyrinths add a quota to tonus activity yet it is not essential to its presence. The higher the mammal the less conspicuous the loss of labyrinthine tonus and the more rapid and perfect the recovery. Whether this is due to the increased compensatory activity, a factor so obvious and generally acknowledged in the development of the higher mammals, or to a retrogression of the vestibular organ has given rise to some discussion. There appears to me but little doubt that a compensation mechanism is the factor to which the change is due, "the greater degree of adaptability on the part of the highly complex somatic motor system" of man. (Wilson and Pike, The Effects of Stimulation and Extirpation of the Labyrinth of the Ear and their Relation to the Motor System. Philosoph. Transactions of the Royal Society of London, 1912, vol. 203, p. 157.)

Role of the Sympathetic.

It has been repeatedly asserted that the sympathetic nervous system plays an important role in tonus. (De Boer, Die Bedentung der tonischen Innervation für die Funktion der Quergestreiften Muskeln. Zeitschrift für Biologie, 1914-15, pp. 239-354.) As was shown above while duality in muscle function rests on a satisfactory basis, duality of nerve supply, somatic and sympathetic, does not appear to me to be established. That in some measure the tonus of skeletal muscles is served by the sympathetic appears to have some experimental evidence but there is no evidence that the sympathetic nervous system influences the postural tonus of skeletal muscles in any marked degree. It is obvious from what

has been said that in postural tonus the main conduction paths of the reflex arc lie outside the sympathetic system. If any connection lie within the sphere of the sympathetic it is presumably near the muscular connections. The evidences in favor of sympathetic relationship may be summed up thus:

(1) Anatomically the presence of sympathetic fibres in voluntary muscle as shown by a nerve fibre splitting, part going to a capillary and part to a muscle plate. It has been claimed that these fibres do not degenerate after section of the motor nerve to the muscle. The presence of the former I demonstrated some years ago in the heart muscle (Wilson, J. Gordon, The Nerves of the Atrio-ventricular bundle. Proceed. of the Royal Society, London, 1909, vol. 81, p. 160), but there the evidence appeared to me to favor a non-sympathetic origin. Further it may well be that fibres arising in the spinal cord pass by sympathetic paths to the muscle.

(2) Disappearance of tonus in hind limb of frog or cat if rami communicantes are cut. This has not been confirmed; further the production of tonus by stimulation of the sympathetic has not been seen by several investigators. (Bayliss, loc. cit. p. 545).

(3) It is well known that adrenaline acts on the nerve endings of the autonomic sympathetic. It has been shown that an injection of adrenaline can produce prolonged contraction without fatigue. But as pointed out by Bayliss (Bayliss, loc. cit. p. 546) this may well be due to increased blood supply.

With such knowledge of tonus as we possess one cannot dogmatically say that such a relationship does not exist, but one can say that it is not proven.

Agencies Which Set the Nerve Impulses in Action.

It is obvious that the stimuli must come from the organism itself since the receptors are shut off from forces external to the body (proprioceptors). Consideration of the data given above point to mass movements, weight, inertia, torsion, etc., as being the deciding factors in labyrinthine stimulation and that mass movements under the influence of gravity are the

deciding influences in labyrinthine tonus. Anatomically the maculæ of the utricle and saccule with their relation to the otoliths are well adapted to mass reaction and the ampullæ with their relation to the semicircular canals and utricle well adapted to react to variations of fluid pressure. Physiologically the experiments of Magnus and de Kleijn show clearly the influence of gravitational forces in the tonus of the trunk and limbs of decerebrated animals. Recently Maxwell (Maxwell S. S. Labyrinth and Equilibrium. Am. J. of Physiol. 1919, vol. 2, p. 123; p. 349; vol. 3, p. 157) has amplified the work of previous investigators and shown that pressure applied to the otolith or movement of it in different directions gives in fish compensatory eye movements and that torsion produced by rotation is the cause of action of the ampullæ. In a recent publication, de Kleijn produced by rotation in mice displacement of the otoliths without damage to the semicircular canals and showed that such displacement was followed by loss of postural tonus. In regard to the anatomical source of tonus in the labyrinth, maculæ (de Kleijn) or maculæ and ampullæ, (Maxwell) there appears at present to be disagreement.

Conclusions.

(1) Tonus is a plastic state of the muscle associated with the maintenance of normal attitude.

(2) This state is under reflex nerve control which automatically produces a modification of the muscle to maintain a particular attitude.

(3) One source from which these reflex nerve impulses arise is the labyrinth.

(4) These labyrinthine reflex nerve impulses, determining the amount of muscle lengthening and shortening together with the degree of fixation, depend on antigravity impulses arising in the labyrinth.

(5) The labyrinth is chiefly concerned with the maintenance of the attitude of the head in space. Necessary to this the labyrinth influences secondarily the muscles of the trunk and limbs.

(6) The muscle proprioceptors are concerned with segmental posture. The labyrinth is concerned with total posture. So far as trunk and limbs are concerned the labyrinth may be regarded as a mechanism superimposed on the segmental.

(7) In unilateral destruction of the labyrinth the deviation of the eyes and neck is due to tonic activity of the other labyrinth.

(8) The stimulation of the nerves in the labyrinth is due to mass movements of the otoliths and fluids in the canals.

Discussion.

Dr. Edward B. Dench, New York, said that it was always a pleasure to hear one of Dr. Wilson's carefully worked up papers. He regretted that his own experimental knowledge was so slight that it was almost impossible to follow his points. This summing up was so carefully made that it marked a decided advance in knowledge of the labyrinth. One would learn more from careful study of the article in the Transactions, than by merely listening to it, and the Society was to be congratulated that this careful study was to appear in its publication.

Dr. Wilson said he wished to bring to the notice of the Society an observation made by Mr. Minton and himself in regard to the relation of tinnitus to nerve deafness. The observation was made while testing the minimum audibility of sound by the audion oscillator. By means of this instrument the minimum audibility can be calculated and charted in terms of electrical energy. In cases of nerve deafness it was found that the pitch of the tinnitus corresponded to the area in the internal ear mechanism where tone perception fell off. It was further noted in some cases that the region which would correspond to the overtones of this primary tinnitus notes gave considerable trouble in ascertaining the minimum audibility in higher tones.

Dr. Charles Richardson, Washington, D. C., asked if that always held good in that particular type of case. Dr. J.

Gordon Wilson said that it held in that particular type of nerve deafness.

Dr. Wells P. Eagleton, of Newark, New Jersey, said that Dr. Wilson had called attention to their shame; that there was scientific work going on this country which specialists know nothing about. Scientific men are of two classes, he said: those whom the public hear a great deal about, but scientific men think little of, and those whom scientific men regard highly, but of whom the public hears nothing.

Dr. Wilson, in closing, said that he would be glad if the men would write to Professor Maxwell for some reprints.

A STUDY IN OTOSCLEROSIS.

By HARRY P. CAHILL, M. D., Boston, Mass.

Clinically, otosclerosis is the term applied to that condition of the ear characterized by progressive deafness, usually bilateral, a normal tympanic membrane, patent Eustachian tubes yet demonstrating the Bezold Triad. The hereditary tendency is marked, varying from 35% in Siebermann's cases to 71% in those of Pierce. Tinnitus is present in over two-thirds of the number and is usually an early symptom.

From a pathological standpoint, the presence of an abnormal new bone formation in the capsule of the labyrinth is the chief characteristic. Unless this new spongioid bone formation has involved the ligamentum annulare and the footplate of the stapes, we have not clinical otosclerosis. Yet involvement of the ligament and the foot-plate of the stapes is only an accident in the progress of the spongification of the labyrinth capsule.

Before one should consider this new bone formation, a brief consideration should be given to the development of the labyrinth capsule itself. It is of cartilaginous bone formation, that is, its form was laid down in embryonic cartilage. The cartilage is an essential support for the growth of such bone. Surrounding the spicules of calcified cartilage, the osteoblasts of the invading osteoid tissue arrange themselves to form bone matrix. Thus, areas of calcified cartilage are completely enveloped by the new formed bone. In the normal long bones these areas of calcified cartilage and the bone in the vicinity are later resorbed and replaced by new bone. But in the labyrinth capsule the areas of calcified cartilage persist throughout life.

The miniature labyrinth vesicle begins to be enveloped by its cartilaginous reduplication during the second fetal month. About the fourth fetal month, that is, in the seventeen centimeter embryo, ossification begins from sev-

eral nuclei in this cartilage. Among these are the opisthotic centre in the region of the promontory,; the pro-otic centre near the superior semi-circular canal and the epiotic, often of double nature, in the region of the posterior semicircular canal. By the end of the sixth fetal month, the vesicle is well encased with bone, and ossification is completed during the ensuing two months. Spread throughout the bony capsule may be seen these areas of calcified cartilage.

Unique, therefore, is the development of the capsule of the labyrinth in these two inter-relating points; first, the cessation of practically any further development after the eighth fetal month, and second, as a result, the persistence of the calcified cartilage areas. For were the growing processes to continue, injury to the now completely developed membranous labyrinth might ensue.

In such unique bone development, new bone formation must necessarily be of a distinct type. The new bone formation in a typical case of otosclerosis is such. There is no evidence of inflammation or injury. Intact mucous membrane lies over the area. So localized is the process, so independent in its growth, so free from signs of inflammation in the uncomplicated case, so unexplainable in its cause, that I have tried to place it under the group of true tumors. If such is the case, it is probably the most benign of new growths. After years of progress, it may measure less than three millimeters square.

A search for the cause or factor producing otosclerosis has led to the development of numerous theories. They range from Siebermann's abnormal resorption of the cartilaginous bone to Gray's aseptic necrosis; from disturbance of the internal organs of secretion to chronic infectious processes. Fraser feels that several or all of these factors may be combined. But if we place the primary cause as due to tumor formation developing about congenital foci, we have an explanation for its predilection for certain areas, that is, the anterior boundary of the oval window, for its bilateral distribution and the hereditary tendency. For Siebermann

found localized sclerosis about the oval window in 5% of cases examined, and Manasse later found congenital isles of cartilage in the same site, bilaterally, in practically the same number of cases. The dividing line between fetal displacements and such a benign tumor, if it is such, is not at all distinct and definite. The best distinction and line of separation is the marked manner in which the new formed tissue transgresses the law of interrelation of tissues. It bursts beyond the labyrinth capsule; it involves the ligament and foot-plate of the stapes itself; it will destroy not only the cartilaginous bone of the capsule but even the membranous periosteal and endosteal layers of the same. Hence it cannot be classed as simply embryonic rests proceeding to maturity.

Upon this theory one in every twenty of us is a potential case of such an abnormality. Required only is the proper factor to light up the process. Whether this contributory element is the result of abnormal secretion is as yet undetermined. Other stigmata of such abnormality are not marked in the majority of cases. Infection, toxemia, pregnancy, do all seem to stimulate the advance of the process. Some investigators feel that they even awaken the potential cases. Among the tubercular and poorly nourished, the same congenital areas are more frequently found. In fact, whatever is found as a contributory factor in bone changes must be considered as a possible agent in this abnormality. Under this grouping, naturally falls diet insufficiency, both as to caloric unit, the salts, and particularly the accessory food elements known as the vitamines. Three of these vitamines are now well established. The presence of two of the three, namely: (1) Fat sol A and (2) C, the antiscorbutic, are essential for normal bone development.

Two distinct types of bone are found in the invading tissue. Type A is a hemotoxylin, basic, staining bone with large cell-rich spaces and narrow spicules, while type B is rose color, due to an affinity for the eosin with thick spicules and small narrow spaces. The former has been interpreted as the most recent formed bone which later

becomes more dense; retains the acid stain and becomes type B. Fraser dissents with this classification and considers the red bone as the only new formed bone and the basic staining bone as the old bone of the area affected by vascular dilatation and increased lymph supply. If we consider this process that of a true tumor, the two types of bone can represent either different periods in the life of the tumor or different rates in its rapidity of growth. For the slower the growth of a tumor, the more time it has for differentiation and the closer it approaches the normal tissue.

The nature of these changes and the steps which have taken place have been the subject of study by Siebermann and Manasse. Whether the original bony capsule disappears through lacunar absorption or by mechanical pressure or chemical action, has been given great consideration. The rapidity of the progress of growth would determine, in a large way, the rate of absorption. The latter would determine whether the osteoblast is to be present or not.

Spongification of the capsule of the labyrinth, or better, the spongioid osteoma, can be present with any of four distinct conditions, and hence with any of four types of hearing tests; type one, in which neither the ligamentum annulare nor the membranous labyrinth have been affected; type two, the typical case with involvement of the stapes. This is clinical otosclerosis and demonstrates the Bezold Triad. Type three, the second stage of type two, wherein the membranous labyrinth has been involved, in addition to the stapes ankylosis. The hearing test, here, manifests perception deafness, superimposed upon the obstructive form. Type four is the pure nerve type due to involvement of the membranous labyrinth or the nerve without affecting the stapes. As to whether this nerve condition is due to pressure on the blood supply of the stria vascularis or to chemical or mechanical changes in the labyrinthian fluids is still an open question.

The more subtle a disease is in its course and the rarer its frequency, usually results the more often in its presence being proclaimed when absent and missed when at hand.

All of us feel that we have seen many more than eighteen cases. Yet Politzer found only that number confirmed by the microscope. Moreover, a typical case is necessary for a certain diagnosis. This is still rarer in New England for the vast majority of the aviation candidates with absolutely normal hearing tests usually demonstrated various degrees of retracted and affected tympanic membranes. In such cases, the true cause of the obstruction deafness would be somewhat obscured.

Treatment.

A consideration of treatment if spongification of the labyrinth capsule is a tumor or fetal displacement seems futile at first glance. But the good results obtained at times with arsenic and Coley's serum in certain sarcomas, with radium and X-ray in other new growths, give all more courage. Siebermann's treatment with phosphorus, based on the good results with it in rickets, seems to act favorably in some hands, while organo-therapy is apparently valuable in others. Calcium and the vitamines, especially the latter, seem to play such a part in normal bone development that a study of their effect is worthy of consideration. Howe demonstrated experimentally bone decalcification in animals fed on diet free of fat sol. vitamines and recalcification when the fat is supplied. This alone should force the consideration of the need of its presence during the puerperium for both mother's and childs' sake in the family with an otosclerotic history. The child need only be brought up to drink sufficient milk daily and the vitamine side is well cared for.

Infection shows a marked tendency to activate the process. This is the more evident in middle ear suppuration. Hence tonsillectomy and adenectomy must be considered upon the slightest provocation. It would be a good general rule to be followed in all early cases. Our greatest difficulty

is and will be the fact that the cases are usually seen and diagnosed when the condition is well established. Any symptoms other than perhaps tinnitus are absent until the growth has made considerable headway. So a halt in its progress by prevention factors seems the only therapeutical action available.

Discussion.

Dr. Norval H. Pierce, Chicago, said that he congratulated Boston for hatching out an otologist who could present such an admirable paper. Much had been added to the knowledge of a very difficult subject. The etiology of otosclerosis was wrapped in utter darkness. The fact that, beginning in one kind of tissue, it invaded another, while suggestive of neoplasm, made it difficult for one to acquiesce in the neoplastic theory, because there was a change in the tissue closely analagous to that in which it originated. All bone was primarily laid down in fibrous tissue, and the fact that the otosclerotic tissue turned into bone did not prove that it was neoplastic in nature. The tissue most frequently invaded the portion of the stapedius ligament at the point where irritation was most pronounced. The posterior portion of the foot plate in its movements was fixed by the stapedius muscle and the anterior portion must vibrate to a greater extent than the posterior portion. Irritation therefore originated in the anterior portion and must play some part. That it was not infectious in the sense of acute otitis media, seemed to be proved by the specimens that Dr. Cahill exhibited. There was complete pneumatization. That was brought out by Wittmack in his studies. Abnormal pneumatization had nothing to do with oto-spongiosis or otosclerosis. Whatever there was to be done from oto-spongiosis must have effect before it began. Siebermann recommended phosphorus, taking their cue from disease of cattle, the beaded ribs closely resembling oto-spongiosis, histologically. Phosphorus ended the softening process. However, when oto-spongiosis had invaded the ligament of

the stapes, phosphorus would do more harm than good by changing a movable ligament into an osseous joint. The nutritional points brought out by Dr. Cahill were interesting and original. In view of the marked hereditary element in oto-spongiosis, children in these families must be watched and nutrition carefully balanced, so that nutritional errors might be prevented. This was one of the most optimistic notes that had been sounded.

Dr. J. M. Ingersoll, Cleveland, said that this was a distinct contribution to the literature on the subject of otosclerosis. One of the characteristics of a malignant growth is that it invades different tissues and shows no respect for normal tissues, and this fact was in favor of considering otosclerosis as a neoplastic growth. Normal tissues respected each other.

This paper offers an explanation for an unsolved problem. The suggestion in regard to nutritional control was very helpful.

The speaker would like to ask Dr. Cahill if he had seen cases early enough to treat them with the X-ray or radium and stop the process, as was done in other malignant growths.

Dr. Max A. Goldstein, St. Louis, said that he congratulated Dr. Cahill on having offered the most concise and modern concept of otosclerosis that they had heard on the floor. It was a matter of considerable pride to the older otologists to know that they were developing younger men in the schools and laboratories to make such work possible. Dr. Ingersoll had touched the vital spot in the pathology of this question. The theory of Mann that cartilaginous cells in growing bone take on new activity certainly indicated malignancy, but one had never had this evidence in otosclerosis. The capsule remained the same, and there was gradual absorption of the bony and membranous tissue in the capsule. The only evidence of a pathological process was the decline of acuity of hearing. One was therefore

on the border line. It might be considered malignant from the standpoint of cartilaginous etiology and there was a peculiar selective tendency with otosclerosis. Brill had demonstrated with madder, a vegetable dye, a select tendency for regenerating bone, and he was waiting to test it in otosclerosis cases to see if it penetrated the labyrinthine capsule.

Dr. T. J. Harris, New York, said that he also wanted to extend his congratulations to Dr. Cahill. The idea of Dr. Cahill's that otosclerosis is of tumor formation, is decidedly original. Further work is required to disprove or to affirm this. To do this requires a careful study of cases which are clinically otosclerosis and the securing of temporal bones upon demise for microscopic examination. By doing so we will be able in time, to arrive at the solution of a question which at present is in the dark. His experiments along the lines of nutrition are encouraging and should be followed up. Before all, we must decide what otosclerosis is. The diagnosis made in the office in the last analysis is in itself not sufficient. The decision must be made by careful data, taken month after month and year after year in connection with microscopic examinations.

Dr. S. MacCuen Smith, of Philadelphia, said that Dr. Cahill had made a presentation which, when further developed, would become a classic. There were not so many cases of otosclerosis as was believed. He wished to emphasize the hereditary feature. From personal observation he knew of a certain family which for several generations back had presented this tendency to otosclerosis. All the descendants, who resembled in feature or traits a certain paternal ancestor, uniformly had begun to lose hearing at an early age —about 17 or 18 years—and nothing stopped the progress of this tendency, although the family were well off and neglected no means to prevent it. This seemed to indicate the importance of heredity. Dr. Cahill had spoken of the nutritional side, and suggested that plenty of milk would

provide the necessary vitamines. It was a question whether pasteurization affected the vitamine content of the milk; also whether the deprivation of beer, in these days of prohibition, did not take away from the workman an important source of vitamines.

Dr. George L. Richards, Fall River, said that if Dr. Dean would make charts of otosclerosis cases they might work out more accurate functional tests. One never knew from the literature whether standard instruments were used or not. If Dr. Dean's instrument was reasonably correct, one might get more definite information as to the progress of otosclerosis.

Dr. Edward B. Dench, New York, said he had listened with great pleasure to this article, and he wished to congratulate Dr. Cahill on the fine slides he had presented. He had never seen such good illustrations or listened to such a clear cut exposition of the whole subject, as they had heard today. Dr. Richards had touched on the tuning fork tests. Some standard series such as the Bezold or the Dean instrument should be used, and it would be well to appoint a committee to take up this matter of standardization with the manufacturers, so that uniformity could be secured. Instrument makers were willing to do this if properly directed. If this were done the upper and lower tone limits could be clearly outlined. Dr. Dench said his hearing was somewhat defective and he would like to get hold of the paternal or maternal ancestor who was to blame, but he had noted in this connection that with the standard Galton he could hear 20,000 double vibrations and with the Bunch instrument only 5,000. Mr. Bunch could not explain the difference. Dr. Harris' point was important, that was to follow up this material carefully. If Drs. Pierce, Cahill and Shambaugh worked as a body they would get good microscopic reports to compare with clinical data, and have very valuable scientific records to send to the other side of the water.

Dr. Wendell C. Phillips, New York, said that in one instance a woman patient had made provision in her will for her entire hearing apparatus to be left for benefit of scientific examination. Such examinations would greatly forward the work, providing a complete record and diagnosis of the case were at hand.

Dr. Charles Richardson, Washington, D. C., said that this paper represented an advance in American Otological work. Those who knew Dr. Cahill expected this type of article and they were not disappointed. One feature in the nomenclature was questionable. The term malignancy was used in rather a different way from the generally accepted meaning, although it was correct as to invasion of one type of tissue by another type. Was this tissue change a mis-step in embryological development, or was it replacement by invasion?

Dr. Chas. M. Robertson, Chicago, said that in Texas cattle not only had rickets of the ribs, but of the long bones, and became bowlegged. They recovered from this. There was bone transformation that resembled oto-spongiosis. Would Dr. Cahill look into this side of the matter?

Dr. Wm. H. Haskin, New York, asked Dr. Cahill if there was any connection between otosclerosis and cases due to focal infection. In arthritis deformans cases one saw a similar condition. Had any investigation been carried out along that line, with the idea of focal infection underlying otosclerosis.

Dr. Arthur B. Duel, New York, said that a distinct advance had been made in the knowledge of otosclerosis in this illuminating paper of Dr. Cahill's. Whether the pathological condition was the result of infection or of nutritional disturbance, it had been definitely put into a class and this was very helpful. There was a very distinct hope

springing up in this classification in the possibility of treatment of these cases by crowding certain lacking vitamines. They all felt a deep debt to Dr. Cahill, and as each man would not be able to voice his feelings he would like to call for a vote to express the sense of all the men present for this valuable contribution.

Dr. Wells P. Eagleton, Newark, said that he felt proud that one of the younger men had put something on the map.

Dr. Harry P. Cahill, closing, thanked every one for their kind expressions. He hesitated about bringing this theory forward. But all embryo pathologists seek the origin of tumors. In the study of otosclerosis, he felt that there was a field for further knowledge. For otosclerosis, according to his tumor theory, seems to mark the dividing line between fetal displacements such as accessory spleens which go on to maturity without invading other tissues, and the true tumor which has independence of growth and no respect for the equilibrium of tissues. Of course, as regards any malignancy, otosclerosis is the most benign of tumors.

Exostoses differ from otosclerosis in that they arise from either the outer or inner surfaces of the bone, i. e., from either the periosteum or endosteum. Exostoses are found often in the insertions of tendons and ligaments. At times they cannot be attributed to inflammatory processes and hence are closely allied to the spongioid osteoma. But they do not have the same power to invade the bone, to absorb and replace it, and are rather a mere excessive proliferation of periosteal bone. Exostosis may, however, be considered under the tumor type of osteomata.

In rickets, the essential pathology consists of irregular, incomplete calcification of the epiphyso-diaphyseal cartilage followed by the formation by osteoclasts of excessive uncalcified bone tissue known as osteoid tissue. This is not the pathology of otosclerosis.

In regard to milk; Rosenau mentions the observation that "winter milk," i. e., the milk of stall-fed cows, shows by its dead white color less vitamine value than the rich golden-hued type of grazing cattle. This must be of vital importance in the consideration of certified milk farms. Vitamines in many ways seem to act as chemical catalyzers. Their presence is more necessary than the absolute amount present. As to the presence of tone islands, they might depend upon how the new bone formation would affect the blood supply of the stria vascularis. This part or that part might be attacked first, but since the new bone formation usually appears near the middle whorl of the cochlea, we can expect lesions in this area. Chemical or pressure (mechanical) changes due to the wide spaces of the new bone coming in communication with the endolymphatic or perilymphatic spaces would affect the entire cochlea, but probably the upper limits first, as these portions seem to be the least resistant.

In regard to the irritation theory, otosclerotic foci have been found in the internal auditory meatus and at isolated foci about the semicircular canals; irritation could hardly account for these lesions, and why infection should attack such areas and the difficulty it would have in reaching them makes infection as the primary factor seem a bit far-fetched. There are no evidences of inflammation, either chronic or acute. The typical otosclerotic case demands this lack of evidence of infection as a cardinal clinical sign.

As to the exacerbations during pregnancy; all tissues show a hyperplasia during such periods and especially is this true of the bony tissues. Until we know more about the fibroblast, the mother cell of the various other connective tissue cells, an explanation of many of the bony changes must be difficult.

In regard to the tendency to bilateral involvement; we must remember that the fetal rest is usually found bilaterally, as shown by Manasse; that the same activating or contributory factor is present in the same being. Congenital malformation of the auditory apparatus is more frequently

found bilaterally, viz.: as seen by the number of congenital deaf mutes. Glioma, mixed tumors of the kidney, and adenocystoma of the ovary are all apt to be bilateral. Hence this is not infrequent in tumor formation.

Dr. Norval H. Pierce, Chicago, made a motion that a committee be appointed by the chair to formulate a movement to consider the whole subject of otosclerosis, and to report back to the Society next year regarding its plans of procedure.

Dr. Edward B. Dench seconded this motion.

Dr. J. Gordon Wilson said that the whole subject was too broad, part of it should be taken.

Dr. Pierce said that the Committee would report back its plan for dealing with the subject as a whole.

The motion was put to the vote and carried.

Dr. Edward B. Dench made a motion that a committee be appointed by the Chair to take up the question of the standardization of instruments for hearing tests, to make a practical set for the average otologist.

Dr. Duel seconded the motion which was carried.

Dr. Eagleton announced that the three delegates of the Society to the meeting in London would be Drs. Birkett, Reik and Forbes.

FURTHER THOUGHTS CONCERNING TESTS FOR AVIATORS.

By CHARLES MOORE ROBERTSON, M. D., Chicago, Ill.

In May, 1918, I had the pleasure of reading a paper before this Society, entitled, "A New Test and Method of Classification for Labyrinth, Muscle Tone and Blood Pressure Findings."

At this time I desire to ask your consideration of certain points which were suggested but which were not then positively proven, and which have been added to in somewhat more extensive observations by myself and others.

To quote from that paper, I first wish to call attention to the type of man which the essayist had in mind as a possible aviator.

"To be an aviator, a man must be physically qualified, his eyesight must be normal without glasses, and his ear must respond to tests for nystagmus, past pointing and falling."

This gives us a man who is perfect as a type, but is this enough?

Again, "For ordinary maneuvring close to earth, the man does not require to be so finely adjusted, for he is in a medium of air almost of the same density and condition as air at the earth's surface. This does not hold true, however, for the aviator who ascends to more than a thousand feet, as when he has attained a greater altitude, he experiences varying conditions of density and temperature, which change in a direct and fixed ratio at the different levels. Were it the practice of the aviator to ascend and descend to any given altitude at a moderate rate of speed, he might not have to be chosen with so much care; but we know that he must change his altitude suddenly, and in many instances

to a great amount, so that he is subjected to violent variations of temperature and especially air pressure, sometimes within a few seconds."

The work which I at that time described to this body had been conducted in the year previous to the reading of my paper, and for that reason it was made before the work which the government was beginning at Mineola, during the early part of 1918. (The Medical Research Laboratory began its active work about April 1, 1918.)

At the time the government was considering the work on tests which it afterward began at the Research Laboratory at Mineola, it was suggested to one of the officers who was active in formulating the research work, that the tests which were at that time contemplated were inadequate, and the writer outlined to the Surgeon General's office that the examinations were not sufficient in scope, as they tested aviators only at ground levels and the result thus obtained would not show how the man would deport himself after the ground conditions were altered by altitude in actual flight. This conversation occurred in May, 1917, which was I think prior to any work done by the government, other than the organization of the different units which were to do the aviation examinations at the several points selected later.

It is not my object to claim priority, but simply mention this fact in passing, to show that the work I am presenting at this time, as well as the work read you in May 1918, was original and if any priority is merited, I naturally seek it.

I do not wish to give the impression that I am trying to tear down anything which was done and I am not antagonizing any of the thoughts that were brought out by the Surgeon General's Office, but rather to tell you how it appears to me and let you form your own conclusions.

It was, of course, necessary to form some hard and fast rules to be a standard in all tests for aviators and the Board which adopted these rules, made it necessary that applicants for the air service should have normal sight, without glasses, a certain fixed amount of accommodation, giving a slight

amount of latitude, and an amount of vertigo upon turning equal to twenty-six seconds, with a variation of eight seconds each way, together with proper past pointing and falling, and furthermore the applicant must be of sound body.

No one could take exception to this ruling, for this gave the examiners a working plan which standardized their methods in the several units distributed over the country. It was thought that a man who had vertigo, must always exhibit his vertigo by an expression of eye movement and that no matter how much, nor how frequent his turning, the resultant nystagmus must be constant. (This view was modified later, but not until the near end of the war.)

After the Orientator was introduced, some of the members of the Otologic service found that vertigo could be reduced in duration and amount, although I have not heard that the loss of nystagmus was admitted.

In my own examinations, it was noted that vertigo was not a constant factor, as it varied at different times in the same individual.

This, however, was not at this time considered as the view advanced by others at that time was accepted as true.

My work was confined to testing men, by putting them through the actual conditions of flight.

I soon found if a man were placed in a pneumatic chamber and the air pressure reduced from the external surface of the body, the nystagmus, past pointing, falling, muscle strength and blood pressure were markedly affected.

My first series of applicants all of whom were enlisted aviator cadets chosen by the Air Service, were put through a test equivalent to a flight which attained one mile in altitude, ascending at the rate of 1,000 feet per minute and being returned to the air pressure at the earth's surface, in 30 seconds, which corresponds to the speed used in an actual flight.

After the flight the cadet was re-examined and the result showed the time of nystagmus was shortened in about 80% when turned to the right, and 90% when turned to the left. (10 turns in 20 seconds.)

Past pointing, falling and muscle strength were affected in about the same proportion. The muscle strength was reduced about 50%, in 80% of cases.

In the second series of cadets, the results were still more pronounced, as two flights were done in succession, instead of one.

Nystagmus was affected in this series in 95% of cases turned either to the right or left. The changes in the blood stream will be taken up in another part of this paper. It was determined in actual service with fliers that the duration of nystagmus varied in the same individual on different days, and after eating, exercise, alcoholic drinking, or taking certain kinds of drugs on the same day. This variation amounted often to 10 seconds, at times higher, but in most cases less in duration.

If a man felt fit the nystagmus was found to be very much less, so I came to regard the length of eye movement in fliers as a very unreliable test. As muscle power controls accommodation, so fatigue, worry, or intestinal imbalance have a decided influence as well as vascular irregularities and it thus becomes a poor index of stabilization. Vertigo lasts no longer than nystagmus, and nystagmus no longer than vertigo. The two are not separable and we found intelligent men who when instructed to indicate by sign, the moment vertigo ceased, would do so at the exact moment the eye movement disappeared. I found that re-turning aviators, together with the training they were receiving from evolutions in the air, actually reduced the nystagmus duration. Thus a man with 16 seconds nystagmus would reduce to 10 seconds or below that amount, while a man with 30 seconds would come down to half or less that amount after he had been turned a number of times.

This, of course, does not include all aviators, as the results in some remain constant, or increased, in such cases however some other element enters to make the man deport himself in this manner, such as staleness or irritability.

Re-turning each day, over a period, should reduce the nystagmus two or three seconds per day, until the nystagmus reduces to a fixed amount or disappears all together, and this reduction, once attained, seems to be almost constant for a considerable length of time, as Griffith[2] has shown after a man whose nystagmus was eight seconds at the end of his practice course, had no more than ten seconds at the end of four months.

What may be said of nystagmus can be said of past pointing and falling as the process involves the same mechanism. We had many cases where men could point properly and where falling was overcome completely. In the test for the fitness of the aviator, the government felt that a test for Oxygen Want was all that was necessary, and you are familiar with the method of examinations made at Mineola and the several camps where the rebreather was inaugurated. I spent six weeks at the Medical Research Laboratory at Mineola, and although the work was extremely interesting, every man doing his best with the task before him, it seemed to me there were important phases of the conditions which the aviator must meet, which were not touched upon and which seemed to me to be vastly more important than low oxygen tension.

The condition which has struck me most forcibly is not oxygen want, but the pressure change in atmosphere to which the aviator is exposed alternately, and sometimes with great rapidity. I made a special point of this in my paper in 1918, and it still impresses me as being the greatest feature to consider in aviation. In the Air Medical Service, published by the Surgeon General's Office, page 25[3], it states, "The flier must undergo abrupt changes in atmospheric pressure and oxygen supply."

"*Atmospheric pressure plays a very important role; the whole problem resolves itself into a deprivation of the normal oxygen supply.*" (Italics mine.)

"The fact that there is "oxygen want" at high altitude suggested that any piece of apparatus that would permit the breathing of a reduced amount of oxygen could be used

to test the ability of men to withstand high altitudes, by changing the oxygen in the rebreathing apparatus, by introducing nitrogen gas, the man can go down to 8 or 7% of oxygen before he succumbs, which is equal to 25,000 to 28,000 feet altitude.

This determination is made on the ground, without danger to the aviator or his machine, and has been taken as a basis for the classification of aviators." This view was not taken by other armies as we quote from the same book, page 112.

Major J. L. Bitley, R. F. C., England, writes, describing symptoms from high flying, which he divides into "Symptoms from fall of oxygen pressure,' Symptoms from fall of atmospheric pressure."

He divides the effects into two heads:

1, During flight, a, vertigo and fainting.
b, nausea and vomiting.
c, pain in one or both ears.
d, frontal headache.
e, desire to micturate and parched tongue.
f, physical fatigue.
g, diminished sense of stability.

2, After flight, a, frontal headache.
b, pain in ears.
c, palpitations.
d, trembling of hands, etc.

He states that "The diminution of pressure on the body surface has, so far as I am aware, received but scant attention."

"The subjective sensations in the lines may be reasonably ascribed to this factor. Remote effects of continued high flying. A great number of pilots present evidence of emphysema, as shown by the percussion note, together with diminution or even obliteration of the normal area of cardiac dullness. In several pilots, the apex beat has been found to be the left nipple line, and in one case one-half inch external to nipple. Several officers have premature beats at regular intervals."

Again on page 125, in a lecture by Dr. Guilbut, French Air Service.[5]

"In descent the heart beats stronger. The heart beats are increased in volume and in proportion to the rapidity of the descent. At the moment he reaches the earth he feels a buzzing of the ears, maybe of such intensity that the pilot is deaf to the roar of his motor even through osseous transmission. He feels a sensation of disagreeable tension in the ears, due to the difference of pressure on the two sides of the drum membrane, on the one side the exterior atmospheric pressure and on the other side the intra tympanic pressure and perhaps the intra vascular." We know when a man goes up in an airplane he is getting into thinner air the higher he ascends, and in doing this the surface of the body is losing pressure on the skin and lung tissue.

This takes the external pressure off the heart, so the pulse accelerates, causing a reduction of the pressure of the blood stream.

This has been established by actual measurement in flight.

On the contrary, in rapid descent, the air becomes more and more dense as the aviator gets nearer the earth's surface, and the pressure which was removed from the external surface of the body, is suddenly and violently applied once more, which acts as a block to the blood entering the surface vessels, causing a back pressure on the heart, with an attendant sudden elevation of the blood pressure.

In lower animals this sudden pressure change has resulted in hemorrhages into the tissues, causing paralysis of motor or sensory areas.

Von Stein found in lower animals frequent hemorrhages into the labyrinth and cerebral hemorrhages causing paralysis of limbs.[6]

German observers have written that in post mortem examinations of fallen aviators the lungs were frequently found torn and cases of rupture of the aorta was found a number of times, caused by the sudden pressure which was put upon the heart and pulmonary vessels.

There were numerous reports of cases where the plane of a fallen aviator was covered with blood, where the subject was not smashed in the contact with the earth at the time of the fall.

I mention this point to show that the body is subjected to immense variations in the blood pressure and we can realize what takes place in the inner ear, when the blood supply is so violently changed, causing an anemia in ascent and an irritation from an ischaemia of the labyrinth in rapid descent.

Many aviators who fell to death retained control of their ship until near the earth's surface, at which time they became unconscious and thus lost the ability to guide their ship.

In my former paper I gave the findings of the blood pressure and told at that time, that of the cases examined some had a great reduction of both systolic and diastolic readings, while others had a sudden rise in the blood pressure, with a few where the findings were not changed.

In my series of cases the time in the cabinet was too short in duration to experience oxygen want, and the change in blood pressure was so marked, that it seemed to me to be of the greatest importance.

My statistics showed that in 94% of cases there was change in the systolic and in 86% in the diastolic pressures.

At that time there were a number of the applicants who had been accepted into the air service in which the blood changes showed pure shock, and those men when allowed to fly should have deported themselves badly.

In those whose blood pressure withstood the strain by being the same or higher after the test, I made a favorable report, recommending them as fit.

I had hoped to be able to report at this time the number of crashes which these young men had encountered, but I have been unable in interesting the government in furnishing the data asked for.

It was my dream to interest the government in the great importance of this side of the problem in their work at

Mineola, but my dream was short lived and the work still remains undone.

There is still another side to this question.

The rotation chair, or better the orientator, demonstrates the fact that a person can become, to a degree at least, immune to labyrinthian stimulation, as indicated by the presence of vertigo with nystagmus, as patients who are treated by rotation in the orientator find after ten or fifteen minute treatments that the vertigo can be overcome in a limited time, varying with the individual.

It is possible, for we know how quickly students learn to past point correctly, and the falling test is reduced to not over five degrees from the vertical, while I have seen many pilots sit straight up as soon as the revolving chair was stopped.

In my paper I made the statement that "provided a man had a functionating labyrinth, the one who had the least labyrinthian stimulation was the best man for flying."

This same man when trained in the chair, or orientator, will soon become immune to vertigo and would be the very best risk possible for a flier, or a balloonist.

I stated that there was a device made to supply our aviators with oxygen, as well as to supply the engine with the same gas, and if this be done the question of oxygen want can be eliminated.

The English government made some reports on squadrons which were supplied with oxygen gas in flights, and they reported the men who were thus supplied did six times the amount of work without fatigue that those not thus supplied could do.[7]

Heating devices aid the aviator in keeping warm, and it may be by this, and a supply of oxygen, perhaps with an amount of carbon dioxide gas, and the dangerous spots may be cut down in aviation, but there can be no means by which the great air pressure changes can be changed, and it seems to me that this is the one thing we should observe if we are to understand the conditions in the science of air navigation.

I am informed that the government has discontinued research work in this field.

They are well equipped and the subject of aviation is with us at this time to remain, for it bids fair to become a common method of travel.

This science is intimately connected with our work and we should use our influence to see that the experimental work is continued.

We will be called upon to give our views on the proper examinations for pilots and men who will be in the business of aerial transportation service and it is possible that a part of our business will include treatment for the prevention of air sickness by some device such as the orientator or some device made for the same purpose.

To me the subject is one of great interest and the more thought I give it the more do I become impressed with the points given you today.

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3. Air Med. Serv., p. 25.
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5. Air Med. Serv., p. 125.
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Discussion.

Dr. Max A. Goldstein, St. Louis, asked for a diagnosis in the case of a lieutenant in the fliers in the A. E. F., who went up with normal hearing and came down deaf. Was that atmospheric pressure, oxygen change, or blood pressure change? Could that be hemorrhage into the labyrinth?

Dr. R. B. Canfield, Ann Arbor, said that this paper was interesting, and should not be at variance with government experiments. Talking over the subject with General Lister at the beginning of the war the speaker said that it would enter into the standards of tests for pilots. In regard to self oxydation, this method could be used for anesthesia.

The rapid respiration which the subject suffered certainly did affect him. Reliable tests concerning equilibration apparatus must be carried out in the airplane. Apparatus on the earth's surface did not reproduce conditions in the air. The roar of the motor produced changes in the auditory and equilibratory apparatus and produced anesthesia of the vestibular tract. The man received less stimulation from the labyrinth. One very successful flier, previous to the war, had a labyrinthine operation. He got by the government somehow. In his own experience, the speaker said that a drop of 5000 feet produced no discomfort until landing, then he was incapable of motion, quite deaf and blind for about a minute, although his equilibratory apparatus was in first class condition.

Dr. J. Gordon Wilson said it was well to have it emphasized, as Dr. Robertson had done that even now little is known in regard to how fliers ought to be chosen and trained. We all acknowledge that at the beginning of the war undue importance was placed on the role of the labyrinth in flight. It is a mistake to regard vertigo as dependent on a labyrinth defect. It ought to be regarded as a disturbance of the whole mechanism of equilibrium. In choosing aviators too little regard has been given to the control of the balancing mechanism by action of higher centres and to the importance of selecting men quick in response to peripheral stimulation.

Dr. H. P. Cahill, Boston, said that with the patient sitting straight, after rotation, he had some sense of muscle pressure of the buttocks which controlled vertigo, even though he felt the floor was tilted. One knew very little of the macule of the sacule of the utricle. Were these tests made in the cabinet, or outside? The same tests hardly applied to safe fliers and trick fliers. Trick fliers had about 20 seconds normal nystagmus time.

Dr. Wells P. Eagleton of Newark, New Jersey, said that Dr. Robertson should formulate some request to go from the Society to the government asking for co-operation, so

that the evidence which had been accumulated by the war could be utilized, and this line of investigation be kept up. "Americans have a right," Dr. Eagleton said, "to expect this of their government."

Dr. Robertson, closing, said that in answer to Dr. Goldstein's question, it would be difficult to tell what happened to that man's ear. In some cases the tympanic membrane became collapsed and stuck to the promontory so fast it was impossible for the flier to inflate his ear. Some of them could inflate the ear during descent, by swallowing, but if one had a cold he could not. It is often necessary to inflate by use of Eustachian Catheter. There might be an exudate in middle ear holding the drum membrane fast to promontory. There might be an element of war neuroses in these cases, which must not be overlooked. The men were high grade fellows with high strung nerves. There might be internal ear shock, due to the drum membrane displacing the stapes, causing concussion.

In regard to Dr. Cahill's remark, the overcoming of vertigo was a matter of deep muscle sense. It might be that vertigo was disregarded by the brain. In regard to tests inside the cabinet, it was not large enough for but one occupant and therefore, men were tested immediately on coming out. The men were examined for nystagmus and past pointing. The manometer was used and when 60 lbs. were pulled the stop watch was snapped and the muscle tonus or the length of time the muscle withstood fatigue before another stimulation was sent from the brain was taken.

Tonus was the length of muscle contraction which succeeds the postural contraction until the muscle is relaxed from expenditure of its tone. If continued contraction is required the brain sends out another muscular pull or postural contraction, which is followed by another period of muscle tonus.

As to the best flier, the scout must not get dizzy and must stand extremes of cold. The least nystagmus with a functioning labyrinth made the best flier.

EPITHELIOMA OF THE EAR: A STUDY OF SIXTY-THREE CASES.

By ALBERT C. BRODERS, M. D., Section of Surgical Pathology, Mayo Clinic, Rochester, Minnesota.

No one should attempt a prognosis with regard to a neoplasm without knowing something of its microscopic nature, its size, and its location. In this series of sixty-three patients, three types of epithelioma from the protective epithelium of the ear were encountered, namely, basal-cell epithelioma or rodent ulcer, squamous-cell epithelioma, and melano-epithelioma. While all of these epitheliomas are cancers there is a great difference in the effect they produce on the patient. It is well known that basal-cell epithelioma is the least malignant and melano-epithelioma the most malignant of the three; the squamous-cell epithelioma is graded between the two. In an article on squamous-cell epithelioma of the lip, I divided the epithelioma into four groups, according to degrees of cellular activity, based for the most part on differentiation. Keratinization or pearly body formation was considered complete differentiation. If an epithelioma showed a marked tendency to differentiate, that is, if about three-fourths of its structure was differentiated epithelium and one-fourth undifferentiated epithelium, it was graded 1; if the differentiated and undifferentiated epithelium were about equal, it was graded 2; if the undifferentiated epithelium formed about three-fourths of the growth and the differentiated about one-fourth, it was graded 3; if there was no tendency of the cells to differentiate, it was graded 4. The number of mitotic figures and cells with single large deeply staining nuclei (undifferentiated cells) plays an important part in the grading. The grade 4 squamous-cell epithelioma cor-

responds in malignancy very closely with the melano-epithelioma, while the basal-cell epithelioma is slightly less malignant than the grade 2 squamous-cell epithelioma.

Of the sixty-three patients in the series 76.19 per cent. were males, and 23.80 per cent. were females; the average age was sixty-one and one-fourth years. Sixty-four and forty-four hundredths per cent. of the males were farmers. Nineteen and four hundredths per cent. had a family history of malignancy; 63.49 per cent. had a history of a previous wart, mole, scab, keratosis, ulcer, eczema, pimple, or lump, at the site of the lesion; 19.04 per cent. had a history of injury or infection. The average duration of the lesion was 4.11 years; the average maximum diameter was 3.22 cm. Eighty-four and twelve hundredths per cent. of the lesions were located on the auricle, 14.28 per cent. in the external auditory canal, and 1.58 per cent. in the middle ear. Forty and eighty-one hundredths per cent. of the lesions in the auricle were located primarily on the helix, 28.57 per cent. on the concha (anterior and posterior surface), 18.36 per cent. on the lobe, 6.12 per cent. on the scapha, 4.08 per cent. on the triangular fossa, and 2.04 per cent. on the tragus.

Thirty-nine and sixty-eight hundredths per cent. of the patients had had nonsurgical treatment, 28.57 per cent. had had surgical treatment, and 53.68 per cent. had had a combination of treatments before entering the clinic.

Of the sixty-three cases, fifty-six were operable and seven were inoperable. In 92.85 per cent. of the fifty-six operable cases treatment was surgical, and in 7.14 per cent. radium alone was used. In 46.15 per cent. of the cases treated surgically radium treatment also was employed, and in 3.84 per cent. x-ray treatment also was employed. In 42.85 per cent. of the seven inoperable cases x-ray treatment was employed, and in 14.28 per cent. radium treatment.

Sixty-one and ninety hundredths per cent. of the epitheliomas in this series are of the squamous-cell type; 33.33 per cent. are of the basal-cell type, and 4.76 per cent. are of the

melanotic type. Of the squamous-cell epitheliomas, 5.12 per cent. are of grade 1, 66.66 per cent. are of grade 2, 23.07 per cent. are of grade 3, and 5.12 per cent. are of grade 4.

Of the seven patients in whom the regional lymph nodes were removed, 85.71 per cent. had metastasis. The involvement of the regional lymph nodes and salivary glands found at operation was as follows: Parotid lymph nodes, 50 percent., external jugular nodes, 50 per cent., parotid salivary glands, 33.33 per cent., submaxillary lymph nodes, 16.66 per cent., superior deep cervical nodes, 16.66 per cent., and inferior deep cervical nodes, 16.66 per cent., most of the patients having involvement in more than one group of glands.

Results.

Forty-seven and five hundredths per cent. of the patients are alive with good results. The average duration of life since the last or only operation, or nonoperative treatment was 3.53 years; 20.58 per cent. are alive with fair results after an average duration of life of 5.44 years; 32.35 per cent. are dead with poor results after an average duration of life since the last or only operation or nonoperative treatment of 1.63 years. Four patients are dead whose results were not reported, or who died too soon after operation to be considered from the standpoint of good, poor, or fair results.

In the cases of melano-epithelioma, 100 per cent. poor results followed treatment.

In the cases of basal-cell epithelioma 58.33 per cent. of the patients are alive with good results, 25 per cent. are alive with fair results, and 16.66 per cent. are dead, with poor results.

In the cases of squamous-cell epithelioma 45 per cent. of the patients are alive, with good results, 20 per cent. are alive, with fair results, and 35 per cent. are dead, with poor results.

In the cases of squamous-cell epithelioma in Grade 1, one patient (50 per cent.) died; the result of treatment is not known; in Grade 2, 50 per cent. are alive, with good results, 25 per cent. are alive, with fair results, and 25 per cent. are dead, with poor results; in Grade 3, 42.85 per cent. are alive with good results, 14.28 per cent. are alive with fair results, and 42.85 per cent. are dead with poor results; in Grade 4, 100 per cent. are dead with poor results.

In the cases with metastasis 100 per cent. poor results were obtained; in the cases without metastasis 100 per cent. good results were obtained, and in cases in which no regional lymph nodes or salivary glands required removal (all squamous-cell epitheliomas) 53.33 per cent. of the patients are alive with good results, 26.66 per cent. are alive with fair results, and 20 per cent. are dead with poor results.

In the cases of lesions in the auricle 51.61 per cent. of the patients are alive with good results, 16.12 per cent. are alive with fair results, and 32.25 per cent. are dead with poor results.

In the cases of lesions in the external auditory canal 66.66 per cent. of the patients are alive with fair results and 33.33 per cent. are dead with poor results.

Results in connection with the size of the epithelioma are as follows: large (4 cm. and over) 50 per cent. with good results, and 50 per cent. with poor results; medium (2 cm. to 4 cm.) 38.46 per cent. with good results, 15.38 per cent. with fair results, and 46.15 per cent. with poor results; small (2 cm. and under) 53.33 per cent. with good results, 33.33 per cent. with fair results, and 13.33 per cent. with poor results.

Of the seven inoperable cases, death is known to have occurred in five. The location of the epithelioma in the seven patients was as follows: in the auricle in three cases, in the external auditory canal in three, and in the middle ear in one.

Discussion.

Dr. S. MacCuen Smith said that this paper indicated a classification of malignancy in which prompt recognition and treatment might be expected to give a fairly large percentage of recoveries. When the auricle was excised, was there recurrence deeper in the canal?

Dr. Norval H. Pierce, Chicago, said that he would like to hear the treatment in detail. Before 1915 cases were treated with surgery, since then with radium, or both, and it would take ten years to get statistics as to the best treatment.

Dr. Broders said that basal cell epithelioma does not metastasize but it infiltrates, and the cases which terminate fatally usually die of an associated meningitis. At present both radium and surgery, either alone or combined, are being used in the treatment of this type of epithelioma.

The secretary said that Dr. Broders had come from the Mayo Clinic, on the suggestion of the American Society for the Control of Cancer. It was felt that his contribution would be very valuable. It had not only resulted in the spread of information, but had stimulated interest in the great problem confronting the whole world.

MISCONCEPTIONS REGARDING THE IMPORT OF RETRACTION OF THE DRUM MEMBRANE.

By EDMUND PRINCE FOWLER, M. D., New York City.

Elemental physiology of the ear teaches that normally the drum membrane is made convex peripherally and concave or funnel-shaped centrally, by its attachment to the more mesially situated manubrium, and that the air pressures upon its two sides are approximately equal owing to free communication with the surrounding air,—constant by way of the external meatus on the one side, and periodic by way of the Eustachian tube upon the other.

The drum membrane is then normally retracted, its central fibres are tensified and curved from the plane of the annulus toward the manubrium, and markedly toward the umbo.

Some confusion or carelessness exists as to the terminology of abnormal drum tensions. Hyper and hypo-tension being used erroneously to denote respectively lack of or increased mobility of the drum. As a matter of fact, hyper-tension denotes immobility only in the sense of an increase in strain upon the drum; whereas lack of mobility may or may not accompany such a strain. Likewise hypo-tension means a loss of tone or lowered strain upon the drum fibres so that increased mobility will coincide with such loss of tone only if there are not limiting adhesions, etc.

We use the term retraction to indicate an abnormal sinking in of the tympanic membrane, and as this may be due to a relatively lessened air pressure upon its inner side, it has become an almost universal habit to think of the condition as diagnostic of negative middle ear air pressure, and of the relief experienced from inflations as due to the restoration of more equal pressures upon the two sides of the drumhead.

However when we examine retracted drums, it is amazing to find that in but comparatively few instances can any negative air pressure in the tympanum be demonstrated. Even in marked cases, with great fore-shortenings of the manubrium and prominence of the processus brevis and posterior fold there may be no vacuum within the middle ear.*

How, then are we to interpret retraction of the drum? I believe we may better understand the matter if we will give it a little thought along the lines I am about to indicate.

The walls of the Eustachian tube, being soft and practically in contact for a considerable distance, are easily approximated more firmly by inflammatory or other swellings in the mucosa or submucous connective tissues. When such occlusions of the tube endure for some time, we are led to believe that there ensues sufficient air absorption from the middle ear and its connecting spaces to appreciably retract the drum. This inward negative pressure tensification may cause diminished hearing, often tinnitus, and at time vertiginous sensations. It also sucks together the walls of the tube (in like manner to the inspiratory effect upon the gill valve of a gas mask) and thus makes more permanent and firm the tubal closure.

If instead of or beside tissue swelling there is present an exudate in the tube, this fluid will not only tend to close the tube as such, but on account of its viscosity will cause the tubal walls to adhere, or as the direction of the cilia motion is pharynx-wise and all transit through the tube can be demonstrated to be more easy in this direction (and for this reason) there will be instituted another cause for exhaustion of the tympanic air, namely,—a suction brought about by the downward movement of the fluid. Depending upon the position of the head, gravity may aid or hinder

*The method for determining air pressures behind the drum was described in detail last year before the Triological Society and the Otological Section of the A. M. A.

this movement. I have been able to demonstrate only during deglutition such automatic movement of the fluid from the middle ear into the tube.

Any lessening of pressure in the tympanum will cause the external atmospheric pressure to predominate, and the drum with its moveable attachments will be forced inward. Two main factors, then, may operate to cause retraction of the drum after occlusion of the tube: First, absorption of middle ear air; second, movement of the fluid contents of the tube toward the pharynx, mainly by cilia motion, and exhaustion of the middle ear air by such hydraulic suction.

If the negative pressure is of sufficient strength, a fluid exudate is expected to fill the tympanum to a greater or less degree.

After failing to find any relavent data in the modern or ancient literature, an attempt was made to determine the exact amount of negative pressure requisite to cause an exudate from mucous membrane. Small cupping glasses applied to the buccal mucous membrane gave no definite findings; in fact, different persons appear to be affected in varying degrees by like pressures. The Schneiderian membrane also gives various results under similar negative pressures in different persons. In hypertrophic rhinitis, an exudate is obtained after a short period of suction; in atrophic rhinitis, but little effect can be produced even with strong suction (over 40 or 50 mm. Hg.) applied for long periods of time, (one half to one hour). This, of course, would be logically expected, and I believe similar lesions within the middle ear and tube may account for the ready or tardy, or non-occurrence of serous or muco-serous exudates accompanying retraction of the drum membrane. In like manner, hypertrophic and atrophic otitis media must influence the ready, tardy, or non-occurrence of air absorption.

Small negative pressures do not cause an exudate into the middle ear, but from the observation of many cases I feel certain that only small negative pressures (15 to 20 mm. Hg. at most) accompany otitis, and that if there be cause marked retraction of the drum this cannot be due to their strength

but rather to the prolonged or oft-remittent presence of negative pressure—first weakening and then allowing of marked recession of the drum.

N. B. –Positive external meatal or negative middle ear pressures up to 20 mm. Hg. depress the drum membrane but little compared to pathological retraction.

I have examined scores of cases with apparently a complete tubal closure, wherein no negative air pressure within the middle ear could be demonstrated by any of the methods I have described for checking this factor. There can be but one explanation for such a failure,– namely, no appreciable air absorption is occurring in these cases. No other deduction seems tenable. Such cases also frequently show little retraction of the drum. Here again there is present no negative air pressure. It is obvious that when the tube is functioning normally, no negative pressure will long endure within the middle ear spaces, and no air absorption operate to retract the drum; but with open tubes marked permanent retractions of the drum are common.

N. B. There is some doubt as to just what constitutes a patent tube. I would say that a physiologically patent tube is one which will permit automatic ventilation of the middle ear especially during swallowing, whether the air in the tympanum is of normal pressure or of lessened pressure due to prior deflation from any cause.

Another finding is that after firmly plugging the external meatus with various cereates, etc., no absorption of air from the external meatus may be demonstrable,—perhaps even after days of waiting.

N. B. As showing how slow may be the air absorption from the body spaces, it is only necessary to remind you that it takes often 8 to 12 days to absorb 1,000 to 2,000 c. c. from the peritoneal cavity, after inflations incident to X-ray diagnosis.

We may thus account for the failure of meatal plugs to effectively hold or pull the drum outward through air absorption. Has any one ever examined a drum after subjection to the supposed suction from meatal plugs and found it

other than in its previous retracted position? I think not. This failure occurs even when the tube is patent. Again, no appreciable air absorption has occurred from the tissues. The external meatus epithelium may be considered to approximate roughly an atrophic state of the mucous membrane of the middle ear. In such states it is reasonable to doubt the ready absorption of air.

Some one will say: Well, you will admit that the drum cannot be retracted without something holding it back? Yes, but, in a way, it may be. How, then?

For the same reason that a bowl is hollow, a section of pneumatic tire concave, a soft hat crinkly. There is insufficient tension at the periphery to maintain the fabric as a flat surface, and the redundant material must take a position to one side or the other of the peripheral attachments. Why, then, is the concavity of the drum usually outward, if there is no difference between the air pressures upon its two sides? Because: First, during the establishment of the retraction, portions of the drum become set in this position and so remain, unless forced outward by inflation or external meatal suction. In fact, slight increases in middle ear pressure may fail to cause local retracted portions of the drum membrane to bulge outward, and strong inflations to maintain bulging but for a few minutes,—far too short a time to account for their collapse by air absorption on their mesial side; second, the tube, not functioning physiologically, there is a tendency to maintain in the middle ear a stationary air pressure. This tendency is often observed, not as an active force in increasing retraction but simply as a preventive of restoration to the centered position of a weakened drum. If there were present a measurable negative pressure, constant stretching of the drum and a constant increase in the retraction would occur; but that such need not be so is evident from the many cases which apparently remain for long periods in status quo. Third, adhesions or fibrous bands between any part of the middle ear and the retracted portion. These may be weak or elastic enough to admit of quite free movement of the membrane, and yet

sufficient to cause its return to the retracted position upon removal of the replacing force. They may be difficult to demonstrate.

Of other causes for retraction, I will not speak at length at this time, but, needless to say, of the utmost importance are adhesive processes, displacement of the ossicles, shortening of the tensor tendon, subluxations, stretching of the ligaments, etc. All these have, I believe, more to do with permanent retraction of the drum membrane than has air absorption.

Conclusions.

Hypertension is not synonymous with immobility of the drum membrane. Hypotension is not synonymous with increased mobility.

Air absorption may be the primary cause of retraction of the drum membrane. It is never over a few millimeters (under 20) of negative pressure,— greater in hypertrophic or congested states; practically nil in atrophic states; and in the latter seldom if ever the primary cause of exudate into the middle ear. It cannot operate with patent tubes or with perforations. It often is absent with closed tubes. It is usually unmeasurable except in active stages of tubal or middle ear congestion. The lesions accompanying retraction of the drum are of more importance from a clinical standpoint than is the negative pressure.

Permanent retraction of the drum is seldom if ever due to the presence of negative or diminished air pressure within the middle ear. This factor as an accompaniment or active cause of drum retraction has been and still is greatly exaggerated.

Discussion.

Dr. J. G. Wilson, Chicago, said that the tensor tympani muscle was the cause of drum retraction. In otitis media the drum was drawn in. One knew little about the influence

on hearing, of retracted drum (not with adhesions). Change of tension would also alter pitch.

Dr. Norval H. Pierce, Chicago, said that the normal contour of the tympanic membrane was largely due to its fibrous elements, and it was not so much retracted in disease as it was flattened. The tympanic cavity was a modified alveolus and it absorbed oxygen and gave off $C. O._2$. This $C. O._2$ stimulated muscle tensor tympanic contraction with consequent retraction of the tympanic membrane.

Dr. J. G. Wilson, Chicago, believed that contraction of the tensor tympani muscle was a more important cause of drum retraction than Dr. Fowler had stated. One knew little about the influence on hearing, of a drum so retracted.

Dr. Fowler, closing said, that the tensor tympani had great influence in maintaining the drum in position. It was impossible to diagnose tensor shortening. The drum membrane was practically inelastic, and that whereas the pitch of the drum was changed by retraction, this did not ordinarily affect transmission of notes as sounds were only transmitted exactly as received, which was a property of all diaphragms (as in the telephone). Except in the acute stages, one did not get negative pressure. There were few totally stenosed tubes. In many stenosed cases the drum was not retracted. How could one explain this if there was an air absorption in the middle ear?

A CASE OF LABYRINTHITIS AND CEREBELLAR ABSCESS.

By CHAS. E. PERKINS, M. D., New York, N. Y.

R. F., male, nine years old, had suppuration of the right ear since infancy. Entered Dr. Dench's service at St. Luke's Hospital, July 20, 1920.

Tests showed hearing in diseased ear for loud whisper 6 feet. Lower tone limit 90; upper tone limit normal; vestibular mechanism active; spinal fluid normal. No history or symptoms of brain involvement.

On July 22nd I performed the radical mastoid operation with primary skin graft. Thirty-six hours later the patient developed vertigo, marked nystagmus to sound side, vomited and complained of headache. Temperature 101 degrees. Total deafness of operated ear, tested with dressings removed. Douching the ear with cold water did not increase the nystagmus or vertigo, with hot water did not produce nystagmus to the diseased side. Spinal fluid contained 350 cells to the millimeter with high polymorphonuclear percentage. Globulin test strongly positive. Right pupil dilated. Eye grounds practically normal.

Labyrinth operation was done after the Neumann method. There was free flow of cerebrospinal fluid from the internal auditory meatus, also from the cochlear region after the removal of the modiolus.

Improvement took place after this operation and convalescence was apparently becoming established. Headache and fever subsided, nystagmus and vertigo became progressively less. This continued for ten days when a free purulent discharge from the region of the internal auditory meatus developed. The patient became drowsy, complained of headache and vomited. His spinal fluid contained 20 cells to the cubic millimeter. Globulin test mildly positive,

overpointed with right hand indiscriminately. As I was off service the subsequent care of the case fell to Dr. Bowers.

Operation August 6th. Sequestrum of bone removed from the region of the internal auditory meatus. This opened an abscess in the cerebellum from which a considerable quantity of pus escaped. Culture of this pus grew the pyocyaneous. An attempt was made to tie off the sinus, in order to obtain more room to evacuate and drain the abscess, but it was unsuccessful on account of hemorrhage which was controlled with difficulty by packing. The patient showed much improvement after this operation. This continued for eighteen days. Then there was an attack of projectile vomiting. Headache, nystagmus to both sides; overpointed to left with right hand; inequality of pupils, right the larger. These symptoms continued for about a week when a further attempt was made to locate and drain an intracranial abscess. The temporosphenoidal lobe was explored with negative results. Cerebellum exposed posterior to the sinus and explored with the grooved director. Upon passing this instrument rather deeply into the upper part of the cerebellum a hard resisting wall was encountered, which at the time was interpreted as the tentorium, but which at autopsy was found to be the thick capsule of an abscess. After this operation there was no improvement. The patient died eight days later.

Autopsy showed meningitis at the base, and "a large abscess, with thick wall, occupying a large portion of the upper two-thirds of the right cerebellar hemisphere extending to within two centimeters of the posterior pole." Cultures of pus from this abscess grew the pyocyaneous.

This case raises several points to which I will allude briefly.

1. Upon opening the dura at the internal auditory meatus there was a free flow of cerebrospinal fluid. I have come to regard this occurrence as an omen of good augury. It doubtless means that the cerebello-pontine cysterna has been opened, and when it occurs the active process seems more likely to be localized in this region. At any rate the

meningitis in this patient began to improve, as shown by the subsidence of the temperature and headache and clearing up of the spinal fluid. The next specimen taken twelve days later, after cerebellar symptoms had developed, showed a cell count of 20 with practical disappearance of the globulins.

2. The question arises as to the time of the cerebellar infection. Whether it occurred previous to the radical operation or, if after it, was it present at the time of the labyrinth operation, or did it take place some ten days later when wound infection became evident with pus discharging from the internal auditory meatus. The importance of fixing this date arises from the fact that it gives the length of time during which a brain abscess may form a thick hard capsule. Dr. Bowers, who performed the later operations and was present at the autopsy, believes that it would have been impossible for such an abscess and capsule to form in the forty-eight days intervening between the radical operation and death, but that it was present in a latent form when the patient entered the hospital. However, it seems improbable that an abscess of such size should occupy and more or less destroy a large part of one cerebellar hemisphere and yet produce no symptoms. More likely the cerebellar infection occurred between the labyrinthitis and meningitis and the wound infection. That is between thirty-nine and twenty-nine days before capsule was discovered upon exploration. So this would be the length of time in which the abscess developed and formed a thick dense capsule. The part played by the pyocyaneus infection in producing a capsule is to be noted. The pneumococcus is perhaps found more often than any other germ in abscesses with capsules. This observation shows that in so far as the germ determines this condition the pyocyaneus is effective.

3. The inadequacy of the grooved director as an exploring instrument is strikingly shown in this case. The resistance of the capsule was so great that it was believed to be the tentorium. Perhaps a sharp knife would have evacuated the pus. It would seem that a procedure advocated by Bal-

lance, which largely has fallen into disuse in this country, might have resulted in locating the abscess. I refer to digital exploration. The finger surely would have succeeded in making out such a large firm abscess.

4. Finally, the difficulty of using the sinus area as an approach is shown. The attempt to tie off the sinus as advised by Ballance and independently by Friesner, failed on account of free hemorrhage which required packing. There are two objections to this procedure. First, one hesitates to inflict sufficient traumatism to the cerebellum properly to insert the ligatures. Second, the resistance of the dura would interfere with their being tied sufficiently tight to occlude the sinus lumen unless they tear their way through, when bleeding would be very likely to occur. So while approach through the sinus area is ideal in those cerebellar abscesses following sinus thrombosis, and has been utilized by McKernon and others, it is not liable to be of very much use when the blood is freely flowing through a patent sinus.

Discussion.

Dr. Wesley C. Bowers, New York (by invitation), said: First, in regard to the possibility of this abscess having formed since the primary operation, I have seen abscess cavities of the brain of three weeks standing in which there was very little demonstrable capsule. In this case, the capsule was almost an eighth of an inch thick and very fibrous. The child was absolutely free of brain abscess symptoms till two weeks after the operation, when suddenly he began to have symptoms of brain abscess. At autopsy the abscess was found to consist of two parts—an anterior part at the internal auditory meatus which I had succeeded in draining, and a large posterior part situated at the upper innermost portion of the cerebellar hemisphere. The minute I drained the anterior abscess the boy was again free from all symptoms of brain abscess; in fact he was up and about, out of doors playing, free from headache, nystagmus and past-pointing for eighteen days after the brain abscess was

drained. Then suddenly he again developed abscess symptoms, which proved fatal two weeks later. I believe that an abscess of this size can remain symptomless for a long time—certainly in this case there were no symptoms for eighteen days after the first abscess was drained.

Second, in regard to the use of a groove director in exploring for brain abscess, had it not been that the abscess was situated directly in contact with the tentorium, I would have passed a knife along the director and explored the resisting mass which I felt with my groove director. I had no way of telling whether this was an abscess or the tentorium, and I did not feel justified in opening it for fear it might be the latter. Had I been using a sharp instrument in this case, I certainly would not have tried to force it in that locality. I have used a grooved director in all parts of the brain, in many directions, in many cases, and have never seen bad results. If I feel the resisting capsule I pass a knife along the groove director. In this case—as I demonstrated at autopsy—nothing but the sharpest pointed instrument could have penetrated the capsule.

Dr. Dench said that statistics had shown that cerebellar abscess, post-mortem, was four times as frequent as cerebral. That was opposite to clinical experience, so that many cases must only be discovered at autopsy, and be without marked symptoms during life. The grooved director was the safest instrument. The sinus should be obliterated by ligatures, using a gauze pad to enfold the sinus.

Dr. G. L. Tobey said that a small canula with an obturator could be used without damage to the brain tissue. The flow of pus was unobstructed.

Dr. Philip D. Kerrison, New York, cited a case of temporosphenoidal abscess recently operated upon by Dr. Byrd. In this case the sole symptom was well marked aphasia. The method of exploration was by means of small carefully placed incisions in the dura, through which the

brain was explored by means of an instrument devised by Dr. John R. Page. This provides two thin parallel blades, which are in close contact when introduced into the brain and may then be separated, allowing pus, if found, to escape between them. The abscess in this case was located by the seventh puncture. Within two days the aphasia had entirely disappeared. Dr. Kerrison opposed the use of a grooved director as less reliable in cases of thickened pus or in abscesses with thickened, resistent walls, than other instruments in use.

Dr. Harris P. Mosher, Boston, said that the Cushing director was used at the Eye and Ear Infirmary in Boston.

Dr. Wells P. Eagleton of Newark, New Jersey, said that in 1902 he opened a cerebellar abscess through the inner wall of a thrombosed sinus. In 1918 he presented to the American Laryngological, Rhinological and Otological Society "an original device for the control of hemorrhage from the large sinuses of the brain, with the report of a successful operation for cerebellar abscess by obliteration of the lateral sinus." (Medical Record, February 15, 1919, Vol. 95, p. 274.)

To control hemorrhage from a sinus completely a special instrument is necessary, as a simple encircling ligature is insufficient. The sinus is held by three fixed points—the tentorium and the external dural walls. One must push the external surface with the obturator into the cavity of the sinus and then ligate, but the external sinus wall must be evulsed first. By thus doing away with the cavity of the sinus is formed a large triangle at the anterior outer part of the cerebellum to explore in.

In ten years time, Dr. Eagleton said, obliteration and ligation of the sinus will precede every cerebellar abscess operation. The capsule is simply a protective effort on the part of the brain to localize the suppuration. It is demonstrable microscopically on the seventh day, and by careful handling may be felt with the exploring instruments on the seventeenth day. In Dr. Perkins's case a little more pressure would have entered the capsule.

Dr. Eagleton wished to call attention to the fact that in Dr. Bowers's case there was no alteration in past-pointing although the patient was carrying around a collection of pus in his head.

THE VALUE AND DEVELOPMENT OF RESIDUAL HEARING.

By MAX A. GOLDSTEIN, M. D., St. Louis, Mo.

The preservation of hearing, whether applied to the child or the adult, has been frequently discussed by otological and medical groups and the viewpoints expressed have usually been centered in special local therapy, surgery and elaborate discussions of etiology. The conservation of hearing as generally considered has included a differential diagnosis between sound-conducting and sound-perceiving types of impaired hearing, destruction or pathological changes of the membrana tympani, ossicular chain or tympanic cavity, contraction or obstruction of the Eustachian tube, the presence of tonsils, adenoids and neoplasms in the nose and pharynx, suppurative processes in the middle ear and its complications, influenza, meningitis and other specific infections, and the less understood local and systemic infections that may give rise to serious disturbances in hearing.

The problem which I desire to emphasize and discuss is the value and development of *residual* hearing, for it includes a different range of subject-matter and its disposition is not necessarily local therapy or surgery. I have attempted to classify deafness into types so that all cases may be definitely classified and better studied clinically.

Group I. Lymphatic Type.

Lymphatic diathesis with hypertrophied tonsils, adenoids in the nasopharynx, lymphoid nodules throughout the upper respiratory tract, pale and soft Schneidorian membranes with tendencies to frequent and various aerobid infections whereby a mechanical blockade of a more or less permanent character is developed in the tubo-tympanic tract tissue metabolism changed and the functions of the conducting apparatus of the ear impaired.

Functional tests usually corroborate the clinical diagnosis of impairment of the sound-conducting mechanism.

In the otology of twenty-five years ago, we found frequent references to large groups of these cases as reported in the statistics of schools for the deaf throughout the country in which the reporters concluded that the aggravated deafness was due to unrecognized and neglected adenoids. At that time, the keen discovery of the immortal Scandanavian, Dr. Wilhelm Meyer, had not yet penetrated the medical profession as an important etiology of deafness.

With the better comprehension of the pathology and surgery of Waldeyer's lymphatic ring, much of the evil aftermath in this group has been held in abeyance. Prompt intervention not only removes mechanical obstruction to ventilation and sound-conduction but also prevents the more serious adhesions, retractions, contractions and absorptions in the tympanic and tubo-tympanic areas where severe and permanent deafness may ensue.

Group II. Exanthematous Type.

As most of the exanthematas have their focal infection in a specific angina and as the local invasion so frequently includes the ear tract, we have a ready accounting for the frequency with which suppurative processes invade the tympanic cavity in this group. These suppurations seem to be of a specially destructive type for the membrana tympani is often sloughed in a large radius, the ossicles necrosed and the walls of the tympanic cavity eroded. Similar erosions are found about the fenestrae ovali and rotundae and these lead to permanent ankylosis or bony changes in this part of the labyrinthine wall.

It is a significant fact that many children with total deafness date their misfortune from an intense invasion of an exanthematous fever. Close observers have concluded that such invasions carry with them not only a destructive process centered in the tympanic cavity but a toxic, selective attack on either a part of the labyrinthine structures, ramus cochlearis, or localized meningitis.

Careful functional tests in this group reveal impairment of both low and high ends of the cochlear scale and often simulate the clinical tests of otosclerosis. There is this difference, however, between an incipient otosclerosis and an exanthematous invasion of the labyrinth—in otosclerosis the basilar and apical Corti cells are involved and a large part of the central scale still functions; in some types of exanthematous invasion of the labyrinth the cochlear cells may be intermittently and irregularly attached producing definitely recognized and still functioning tone-islands throughout the cochlear scale.

Group III. Central Type.

In epidemic meningitis, poliomyelitis and exanthemata with intense febral reaction, we frequently find a sudden attack on the auditory central organ and total deafness. The following brief clinical report will illustrate: An intelligent, normal girl of sixteen was attacked Christmas Day by epidemic meningitis with all of the characteristic symptoms of this infection; was seriously ill for a week, joined the family at dinner New Year's Day recovered from meningitis but totally deaf. Here again we note a selective localized meningeal attack on the nerve trunk.

Functional tests with all forms of sound-producing apparatus including tuning forks, voice, musical instruments and gongs failed to produce any sound impression. Even if the labyrinth end-organ has escaped attack, if both auditory nerves in their trunk have been toxically invaded and destroyed, the deafness must be complete.

Group IV. Otosclerotic Type.

Much has been written about otosclerosis but we are still undecided as to its pathological entity. As it occurs less frequently in the child and the youth than in adult life, it does not figure to so large an extent in this problem of residual hearing and its development.

There are several clinical and pathological data which seem fairly constant in this group. We have every reason to believe that a spongifying or sclerotic change in the labyrinthine capsule takes place; the point of most frequent attack

seems to be about the foot-plate of the stapes; the membrana tympani frequently shows no change in plane or lustre other than a circumscribed pink spot; the tuning-forks and Galton whistle give evidence of a diminished perception for both low and high tones; bone conduction is prolonged beyond the normal and a paracusis is usually present in incipient cases.

Group V. The Congenital Type.

One of the most serious factors in the production of profound deafness is that of congenital transmission. Interesting statistics have been compiled showing the large percentage of total deafness evolved in the matings of the congenitally deaf and of consanguinous marriages. We are here concerned not with a pathological but with a biological question. At a former meeting of the American Otological Society I showed among a series of microscopic sections of the labyrinth one of a congenitally, totally deaf child. The most interesting phase of this specimen was that the cochlear nerve in the labyrinth was shown to consist of only a nerve sheath and contained no vestige of neuroglia or nerve substance; the nerve presented the appearance of an empty shaft. Or, we may find a congenital atresia or absence of the external ear or of the tympanic cavity or its contents and a consequent unestablished (?) hearing mechanism. These brief descriptions illustrate my point of a biological absence of tissue rather than a pathological destruction or degeneration.

A functional test with tuning-forks and other sound-producing apparatus in this group elicits no response to any sound-perception for if the cochlear or peripheral element is absent, no central, sensory impression can be conveyed.

Group VI. Hereditary Type.

We should distinguish between the congenital type in which a transmissable absence of a part of the auditory nerve mechanism may be found and the hereditary transmission of a degenerative element as in ricketts or syphilis. In syphilis the cochlear nerve or the ramus cochlearis may be present but may have undergone sufficient degeneration in embryo or in early childhood to present decided pathological entity.

Functionally such a differentiation could perhaps not be made by sound tests. Here we might avail ourselves of the Wassermann reaction, preferring spinal puncture to blood examinations, and it is not unreasonable to hope, if such laboratory findings corroborate a syphilitic diagnosis, that an anti-syphilitic treatment may, even in cases of profound deafness, produce improvement in hearing.

Group VII. Benign Type.

Impaired hearing caused by recurrent coryza, deflected septum, hypertrophied turbinates, polypi (mucous or fibrous), adenoids, tonsils, malformation of the palate and choanae, chronic suppurative otitis media, large perforations of the membrana tympani, etc., where the mechanical influences of obstruction have not developed permanent secondary pathology, such as adhesions, obstructions in the tube, necroses of the ossicles, partial destruction of the tympanic walls, may be classified as a separate group where the necessary surgical and therapeutic treatment may greatly improve the hearing and restore practical auditory usefulness.

A long experience in the examination and observation of deaf children leads me to the definite conclusion that functional tests to determine the degree of profundity of deafness as carried out by the otologist is of less practical value or application than similar conclusions reached by the experienced teacher of the deaf. The main dependence of the otologist for differential diagnosis of the functioning character of the ear is the tuning fork, but when a profound degree of deafness exists as is the case in so large proportion of congenitally deaf or even adventitiously deaf young children the tuning fork becomes a factor of lesser value.

To cite a practical example: The parent of a two or three year old child consults the otologist as to his auditory status. The parent states: "I think my baby must have heard for when it was about one year old it seemed to prattle and babble and apparently observed persons and things and showed some sense of direction to sounds. Six months later the child had a sudden febrile attack for several days (perhaps teething, grippe, enteritis, etc.) and since then he babbles

less and does not respond to the sound of voices when trying to attract his attention. Loud noises and the clapping of hands startle him but do not seem to arouse him. Doctor, is my child totally deaf and what do you advise me to do for him?'' The report of the otologist which usually accompanies such a case states: ''This child hears neither voice nor tuning forks and I have referred the parents to you for advice and educational direction.'' With this brief experience the otologist thinks he absolves his responsibilities in such a case.

Later observation in the course of the mental unfolding of such a child often reveals the presence of an uneducated or latent auditory word center, imperfect Wernicke, lack of correlation between Broca and Wernicke or some other undeveloped or imperfectly stimulated speech or hearing center.

It is to the minute study of these speech and hearing centers and their more intimate relation to the various types of serious deafness that I wish to direct your attention and more earnest consideration. Our experiences in the reeducation and mental reconstruction of soldiers made deaf and defective in speech by shell-shock, shell-concussion and war casualties has proven the practical value of the careful study of these centers and has substantiated the theories and physiological findings attributed to these brain areas. The practical results of reeducation or restimulation of speech and hearing have been so thoroughly demonstrated in the group of reconstruction cases in our experience that the importance of similar measures applied to the training of the deaf child cannot be too greatly emphasized.

Residual hearing or remnants of hearing are vital elements in the pedagogic training of the deaf child. Such hearing remnants may be so negligible as to offer but limited reconstruction material; on the other hand, as has been frequently stated, thirty per cent of all children found in schools for the deaf throughout the country have sufficient residual hearing to perceive the human voice to varying degree (from the hearing of elementary sustained sounds to that of fluent speech, and the cultivation of this residual hearing may, in

a large group of such children, place them in a position where they may eventually be considered only as hard-of-hearing individuals instead of as deaf-mutes.

Attempts have been made to classify the degrees of deafness. I have carefully analyzed such claims and statements but fail to find on what standard or basis such estimates are made. Reports have been sent to me with the statement of the otologist: "This child has fifty per cent hearing; this child has twenty-five per cent hearing." I must admit that with our present classification of the degree of deafness, I am unable to understand just what is meant by such a statement.

I think it would be a very practical asset to develop such classification but it must be dependent on definite standards and on careful otologic and pedagogic tests.

The status of the deaf child of the future will be best recognized by a liberal co-operation between the otologist, the psychologist and the experienced teacher of the deaf.

Many of the observations included in this paper require further careful corroboration to make them of definite scientific strength. If the classification of nerve-deafness into the several groups above referred to is scientifically consistent and if the results of the application of the Acoustic Method depend on the stimulation or reeducation of unawakened, toxicised or degenerated nerve tissue, we should be in a position to even establish a pedagogic prognosis. We must consider the history of the pupil, congenital and hereditary factors, the character of the disease from which deafness dates, the general physical and mental development of the case and the responsiveness of the pupil to systematic acoustic training. There are imperfections in the pedagogic training; much of the physiology and pathology of the acoustic mechanicism is still but vaguely understood, a comparatively short time for practical study and impartial analysis has elapsed and larger groups of pupils must be observed by specially trained teachers and otologists to summarize the end-results and establish a practical potentiality.

There has at last been an awakening of the otological profession to the significance and importance of this problem and as soon as more of our colleagues study these questions seriously a new era for the deaf child is sure to develop.

Discussion.

Dr. Edward B. Dench said that residual hearing was very important. A child 3 years old had islands of hearing with the tuning fork. The parents were well to do and gave the child a private instructor and at 16 he was ready for college, could speak English, German and French, and understand almost as well as a normal individual. The adult becoming deaf also need reeducation.

Dr. J. Gordon Wilson, Chicago, asked what method Dr. Goldstein used. The great difficulty with the average otologist was lack of time.

Dr. D. Harold Walker, Boston, said the question of disease was important. He encouraged his patients to use the acousticon or electrical hearing aid, to listen to reading aloud and to use the telephone or anything that would exercise the faculty of hearing and increase its use.

Dr. H. P. Cahill, Boston, asked if lip reading decreased the ability to hear.

Dr. Norval H. Pierce, Chicago, said that in an Institution for the Deaf and Dumb, he found 10 per cent of children ranging from 6 to 16 years who could hear whisper at 3 feet and spoken voice at 10 feet, and these were living a life of silence, being taught the sign manual. Reform was being but slowly instituted.

Dr. Charles Richardson, Washington, D. C., said this was an important paper, but four men could not do all the work unless the Society would stand back of them. As Dr. Goldstein said institutions paid little attention to speech reading.

In New York Fenwood was a manual school. One girl had been seen recently, deaf, dumb and blind, who could speak well, and reply to questions even spoken through a roll of paper. Sitting between two companions she could understand their speech by transmission of vibrations. The residual hearing of children could be reeducated and the absurd manual methods must be stopped. What these children needed was contact with normal life.

Dr. Frederick L. Jack, Boston, said that the Aural Advisory Medical Board of the Public Schools of Boston, had invited Dr. Goldstein to give his idea of the proper method of instruction of deaf children. He had found the method of teaching not too bad, but thought it could be improved along lines suggested by him.

Dr. F. P. Emerson, Boston, said that he was glad to find he did not differ from Dr. Goldstein in this question. He would like to know if progressive deafness was tubo-tympanic, and when perception deafness began.

Dr. Goldstein closing said that he was becoming a regular itinerant lecturer. The question of training was one of physics of sound: music vibrations, the human voice, Betzold forks were all employed. A blow organ was used as music had a special reeducational value. The earlier the child began its training the better. Sometimes a child only heard one note, and that was dinned into it until it made an impression from peripheral to central apparatus. Increase of the tone range was gradually accomplished, until 5 or 6 octaves were used. Two octaves might take a month or a year. The tone island was what they were after, and expansion from that. The children learned round the piano and got the right vibrations. The girl Dr. Richardson mentioned got sound by tactile impressions and that bore out the theory that all special senses were modifications of the tactile sense. The acousticon was avoided if possible as it distorted the human voice. Children were better subjects than adults. After 15 little impression was made as the muscles of speech

were stiff. In regard to manual training, that did not harm, but much harm was done by trying to combine oral training with signs. The child learned neither. Dr. Goldstein said he took six children trained by the oral method, for demonstration to the legislature, and the chairman of the board told him he did not need any bill. Still they needed the support of the otological and the trilogical societies. Many of the states were out of date in their methods. The deaf child had as much claim as the normal child. There should be committees in all large cities and a central committee as a clearing house. Dr. Goldstein said he had had to introduce Dr. Jack, a prominent New England otologist, to the Horace Mann school in Boston. The support of otologist was needed in all the large cities. No matter how busy a man was he was needed in this work. Dr. Goldstein said he was willing to spend the best part of his energies in this work for the rest of his life, but he needed support.

A COMPARATIVE STUDY OF THE BLOOD VESSELS IN THE LABYRINTH OF THE EAR.

DR. DENJIRO NABEYA.
(From the Anatomical Laboratory of the University of Chicago.)
Presented by GEORGE E. SHAMBAUGH, M. D., Chicago, Ill.

Read by title.

In this research Dr. Nabeya worked out the vascularization of the membraneous labyrinth of the guinea pig, the rabbit and the cat. Dr. Nabeya relied chiefly on the method previously used by Eichler, Siebenmann, Asai and Shambaugh of making celloidin casts of the cavities of the internal ear after injecting the blood vessels with Prussian blue. He supplemented the study of these casts by a modification of the Spalteholtz method of rendering anatomical preparations transparent.

In the three species studied by Nabeya, the arterial supply conformed closely to the same general scheme which Siebenmann had found in the human, Asai in the dog and the rat, and Shambaugh in the pig, the sheep and the calf. A single artery supplies the entire labyrinth which enters along the internal meatus. The first branch from this main trunk follows the ramus utriculus ampullaris of the eighth nerve and is distributed to the macula acustica of the utricle sending branches to the anterior crurae of the horizontal and superior canals. The second branch supplies the opposite crurae of these two canals as well as the crus commune. The terms anterior and posterior vestibular arteries respectively, are usually applied to these vessels. The relation of the second of these arteries to the vessels supplying the basal coil of the cochlea differs in different animals. In the guinea pig, Nabeya found two parallel arteries supplying each crus of the semi-circular canals, a condition not observed in other animals studied.

A peculiar interest is attached to the findings of Nabeya in the venous system because of the difference observed by Shambaugh in the species studied by him and the findings of Siebenmann and Asia. The latter observers had found three venous trunks draining the membraneous labyrinth. One vein left the labyrinth along the aquaeductus cochleae, a second along the aquaeductus vestibuli and a third along the meatus acusticus internus. Shambaugh, on the other hand, had found in the domestic pig, that all the veins from the membraneous labyrinth united into one trunk which left along the aquaeductus cochleae. Exactly the same relation was also found in the sheep, while in the calf he found as an anatomical variation an occasional small vein from the crus commune leaving along the aquaeductus vestibuli. Siebenmann in reviewing the work of Shambaugh, suspected the failure of the latter to find a vein leaving along the internal meatus was due to the destruction of this vessel in the making of the celloidin casts. Nabeya in his studies made a special effort to determine this question of the veins leaving the labyrinth and by the methods employed left no possible chance for destruction of these vessels. His results are in complete accord with the observations of Shambaugh. In both the guinea pig and the cat, all the veins leaving the labyrinth are collected into a single trunk which leaves along the aquaeductus cochleae. In the rabbit he found in addition to this vein, a vessel draining the vestibule and semicircular canals which leaves the labyrinth along the aquaeductus vestibuli. In the cat alone was he able to make out a vein in the meatus internus, which however he does not believe is a vessel belonging to the internal ear.

As a rule there are two veins which drain the vestibule and the semicircular canals, the anterior vestibular vein draining the region supplied by the anterior vestibular artery and the posterior vestibular vein draining the region supplied by the posterior vestibular artery. Shambaugh had found in the sheep that the anterior vestibular vein

was wanting and that all the veins from the vestibule and semicircular canals were collected by one trunk, the posterior vestibular vein. Nabeya found in the cat a similar arrangement by which a single vein drains the utricle and all of the semicircular canals.

No blood vessels as a rule are found either in Reissner's membrane or connecting the vessels of the lamina spiralis with those of the spiral ligament, the zona pectinata of the membrana basilaris remaining free from vessels. Shambaugh had found in the pig that the membrane of Reissner was without blood vessels, but in the zona pectinata he found an occasional vessel connecting the spiral vessel under the tunnel of Corti with the vessels in the spiral ligament. In the sheep and the calf he found vessels in both the membrane of Reissner and in the zona pectinata. Nabeya found in the guinea pig no vessels in Reissner's membrane or the zona pectinata. In the rabbit, however, he found vessels in both of these structures.

DEMONSTRATION BY DR. DAY.

Dr. Ewing W. Day, Pittsburgh, demonstrated a technic for estimating the oscillations of the cerebral fluid, as shown under normal or abnormal pressures. This might be useful for clearing up diagnostic points. Under normal conditions the brain showed pulsation, unless under great pressure pulsation is absent. A pressure much higher than the normal 120 mm. indicated a cerebral lesion. The normal circulation of the cerebral fluid was by the lateral ventricles and foramen of Munroe, then through the Sylvian aqueduct to the fourth ventricle and the arachnoid spaces. There is no organ which regulates circulation of the cerebral fluid, therefore it probably is controlled by respiratory movement. The fluid falls with inspiration and rises with expiration. If the ventricles are unobstructed, a marked oscillation of the fluid in the tube occurs; if obstructed, the oscillation is diminished or absent. Accumulated evidence would show whether this estimation would be of diagnostic value in the future. The apparatus consisted of a lumbar puncture needle attached to a glass tube 1 m.m. diameter, 5 c. m. long.